DOCUMENT RESUME

ED 170 610	CE 021 540
TITLE	General Mechanical Repair. Minor Automotive Maintenance. Volume 1. Teacher's Guide.
INSTITUTION	East Texas State Univ., Commerce. Occupational Curriculum Lab.
SPONS AGENCY	Texas Education Agency, Austin. Dept. of Occupational Education and Technology.
PUB DATE	78
NOTE	513p.; For a related document see CE 021 541 Parts may not reproduce clearly due to colored background
AVAILABLE FROM	Occupational Curriculum Laboratory, East Texas State University, Commerce, Texas 75428 ($5.40)
EDRS PRICE	MF02 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Auto Mechanics; Behavioral Objectives; Electrical Systems; Instructional Materials; Learning Activities; Objective Tests; Safety; *Trade and Industrial Education
IDENTIFIERS	Brake Systems; Engine Principles; Exhaust Systems; Fuel Systems; Lubrication Systems, Cooling Systems; *Minor Automotive Maintenance; Steering Systems; Technical Skills; Tires; Transmissions (Automotive)

ABSTRACT

Fourteen units on minor automotive maintenance are presented in this teacher's guide. The units are the following: introduction to minor automotive maintenance, shop safety, engine principles, fuel system operation and repair, electrical system, ignition system, lubrication system, engine cooling system, exhaust system, wheel bearings and tires, brake system, frame suspension and steering, drive line, and cleaning the car. Each instructional unit generally contains eight components: performance objectives; an outline of minimum instructor and student activities to accomplish unit objectives; information sheets presenting basic unit content; transparency masters; job sheets which outline skills to be achieved; student assignment sheets related to the unit information sheets (answer sheets are provided); and objective tests with answer sheets. (JH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED170610

CE 021 540

GENERAL MECHANICAL REPAIR

MINOR AUTOMOTIVE MAINTENANCE

Volume 1

Teacher's Guide

MATERIALS DEVELOPED AND DISTRIBUTED BY

Occupational Curriculum Laboratory
Secondary and Higher Education
East Texas State University
Commerce, Texas

IN COOPERATION WITH

Texas Education Agency
Occupational Education and Technology
Austin, Texas

"PERMISSION TO REPRODUCE THIS MATERIAL IN **MICROFICHE ONLY** HAS BEEN GRANTED BY

C. K. Laughlin

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

FIRST EDITION

1978

©1978 by Occupational Curriculum Laboratory,
East Texas State University
All rights reserved.

Brand names, company names, trademarks, or other identifying symbols appearing in the text are used to clarify and identify and do not constitute a recommendation or endorsement.

ETSU, an Equal Opportunity University, complies with all federal requirements prohibiting discriminatory activities.

FOREWORD

This publication is one part of the instructional materials for students in General Mechanical Repair. These instructional materials were developed as a result of a project funded by the Texas Education Agency to the Occupational Curriculum Laboratory at East Texas State University. The materials were developed with the assistance of Gener Mechanical Repair instructors across the state.

This publication can provide instruction for the skills to be acquired for entry level into various occupations in the General Mechanical Repair cluster. These materials can also provide a better mean of communication in classroom instruction. To accomplish this, both teacher and student guides are printed.

The teacher's guide includes objectives, suggested activities, references, information sheets, assignments, job sheets, tests, and answer sheets.

Student manuals include the objectives, information sheets, assig ments, job sheets, and tests so that the student may follow the instruction or add additional job-related information.

Every effort has been made to make this publication basic, readable, and by all means, usable. Three vital areas of instruction (motivation, personalization, and localization) cannot be included in this publication and will have to be provided by the instructor. Only then will this publication become a meaningful part of the teaching-learning process.

USE OF THE INSTRUCTIONAL UNITS

Units of instruction in General Mechanical Repair are written for the shop program. Each unit, which covers more than one classroom period, contains the basic components: performance objectives, suggested activities, information sheets, assignment sheets, assignment and/or job sheets, transparency masters, and a unit test with answer key.

Careful study of each instructional unit will enable the teacher to determine:

A. The amount of material that can be covered in each class period

B. The skills that must be demonstrated

C. The supplies and equipment needed for skill performance

D. The amount of classroom time needed for teacher demonstration and student practice

E. Supplementary materials that must be ordered

F. Any resource personnel who must be contacted

The specific components of an instructional unit perform the following functions.

OBJECTIVES

Each unit of instruction is based on performance objectives. These objectives specify the exact behaviors the student will be exhibiting, thus providing students with a sense of direction.

Performance objectives are stated in two forms. The unit objectives state the materials to be covered in the unit of instruction and how the student will handle the materials. Specific objectives state the types of performance the student will be doing to satisfy the unit objective.

A classroom discussion should follow immediately after the students read the objectives so that any questions concerning the performances expected of the student can be answered.

SUGGESTED ACTIVITES

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives.

Instructor. Duties of the instructor will vary from unit to unit, but the following are minimum activities for the instructor:

1. Provide students with objectives, information, assignment and/or job sheets
2. Discuss objectives and information sheets
3. Make transparencies
4. Demonstrate procedures outlined on job sheets (when included)
5. Give test

Any additional instructional activities and teaching methods to aid students in accomplishing the objectives are strongly encouraged.

Student. Student activities are listed to help the student achieve the objectives of the unit.

INFORMATION SHEET

Information sheets provide content essential for meeting the cognitive requirements of the unit. These sheets provide an excellent guide for presenting necessary knowledges necessary to develop the skills specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students are encouraged to make any additional notes on the information sheets to help them in their learning process.

TRANSPARENCY MASTER

Transparency masters provide information in a special way. Transparencies may present new information or may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Make the transparencies from the masters and place them in your notebook ready for immediate use.

Copies of transparency masters can be made and used as student handouts to supplement the material contained in the information sheet.

JOB SHEET

Job sheets are an integral part of each unit of instruction. The instructor should be able to demonstrate the skills outlined in the job sheets. Procedures specified in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress in preforming the skill. Job sheets provide a ready outline to students and furnish to potential employers a picture of the types of skills being taught.

ASSIGNMENT SHEET

Assignment sheets give direction to study and furnish activities which provide application of the knowledges contained in the information sheet. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided for checking student progress.

UNIT TEST

Unit test questions have been constructed to measure student achievement of each specific objective listed on the objectives sheet. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Tests or quizzes should be reviewed after grading to reinforce correct information.

ANSWERS TO UNIT TEST

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

PERSONALIZING AND LOCALIZING INSTRUCTIONAL UNITS

Carefully review the instructional units before using the unit in the classroom. In reviewing the units, you may find it necessary to localize and personalize the units based upon the needs of your students.

Some of the ways of supplementing units are the use of audio-visuals, attention-getters, field trips, resource personnel, games and simulations, case studies, peer teaching, role-playing and personal experiences of both the teacher and students.

Various methods may be used in localizing a unit of instruction. You may wish to apply units of instruction to the local community, add additional materials from newspapers and magazines, invite local resource people, and arrange field trips.

In personalizing a unit of instruction, you may want to make the course content relevant to home and/or work situations. You may wish to involve students in the planning of the unit by using their own personal experiences. Having students involved in the teaching of some of the materials is sometimes an effective example of peer teaching.

Remember that as an instructor, you may wish to add other objectives to the units of instruction based on the individual needs of the student. If this procedure is followed, you must add any assignment or job sheets as deemed necessary and construct a corresponding unit test item.

TABLE OF CONTENTS

Foreword iii

Use of the Instructional Units v

UNIT NUMBER	UNIT TITLE
I	INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE
II	MINOR AUTOMOTIVE SHOP SAFETY
III	ENGINE PRINCIPLES
IV	FUEL SYSTEM OPERATION AND REPAIR
V	ELECTRICAL SYSTEM
VI	IGNITION SYSTEM
VII	LUBRICATION SYSTEM
VIII	ENGINE COOLING SYSTEM
IX	EXHAUST SYSTEM
X	WHEEL BEARINGS AND TIRES
XI	BRAKE SYSTEM
XII	FRAME SUSPENSION AND STEERING
XIII	DRIVE LINE
XIV	CLEANING THE CAR

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

UNIT OBJECTIVE

After completion of this unit, the student will be able to explain the history of the automotive industry. The student will also be able to explain information on careers, nature of work, and qualifications of the automobile mechanic. This knowledge will be evidenced by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student will be able to:

1. Match the inventions associated with automotive history to the inventor.
2. List five careers found in the auto industry.
3. Name four duties of the auto mechanic.
4. Demonstrate the ability to:
   a. Locate information on the local job market.
   b. Inquire about the nature of work involved at a place of business employing automotive people.

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide students with objective sheet.

   B. Provide students with information and assignment sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and assignment sheets.

   F. Discuss directions outlined on assignment sheets.

   G. Give and evaluate test.

   H. Review questions missed on test.

II. Student

   A. Read objective sheet.

   B. Study information sheets.

   C. Participate in class discussions.

   D. Complete assignment sheets.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM-1--Evolution of the Automotive Industry

      2. TM-2--Careers of the Trade

D. Assignment sheets

  1. Assignment Sheet #1--Locate Information About the Local Job Market

  2. Assignment Sheet #2--Interview a Manager of an Automotive Business

     (Note: This can be accomplished through the use of a guest speaker.)

E. Test

F. Test answer sheet

II. References

A. Duffy, Joseph W. Power Prime Mover of Technology. Bloomington, Indiana: McKnight and McKnight Publishing Company, 1964.

B. General Mechanical Repair - Suggested Basic Course Outline. Commerce, Texas: East Texas State University, 1975.

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

INFORMATION SHEET-SECTION 1

I. History of the internal combustion engine

  A. The first reciprocating internal combustion engine

    1. Invented by Christian Huggens, a Dutch scientist

    2. A piston engine driven by gunpower

    3. Never used because of hazards

  B. Gas engine using a constantly lighted flame outside the cylinder

    1. Invented by Samuel Brown in 1823

    2. A gas and air mixture was ignited inside the cylinder.

  C. William Barnett's engine

    1. Used a mixture of air and gas produced by a separate pump

    2. Was too expensive and cumbersome to operate

  D. The first practical engine

    1. Invented in 1860 by Pierre Lenoir

    2. Used an electrical spark produced by an induction coil.

  E. First four-cycle engine

    1. Invented in 1862 by Beau DeRochas

    2. Used the same cycles as a conventional four-cycle engine

  F. First successful engine

    1. Designed in 1876 by Dr. N.A. Otto

    2. Used four strokes known as the "Otto cycle"

G. First patented gasoline engine

  1. Produced by Gottlieb Daimler, manager of Otto's engine works

  2. Used gasoline vaporized by a carburetor

H. Future of the internal combustion engine

  1. By 1897, much work was done in Germany, France, England, and the United States on overland vehicles driven by internal combustion engines.

  2. The motor car was the product of many people.

  3. After 1900, the internal combustion revolutionized the mechanically propelled road vehicles

II. Careers in Automotive Industry

A. Cars are being assembled at the rate of one per minute in the United States.

B. Careers include:

  1. Designing

  2. Welding

  3. Assembly line workers

  4. Painting

  5. Maintenance

C. Much talent, interest, and ability are needed in the automotive field.

III. Nature of work involved

A. Performs repair and tune-up of motor vehicles

  1. Repairs and adjusts

    a. fuel systems

    b. electrical systems

    c. cooling system

2. Installs
    a. spark plugs
    b. oil filters
    c. air filters
    d. fan belts
    e. batteries
3. Services auto with
    a. oil
    b. grease
    c. gasoline

B. Works a 40- to 48-hour work week

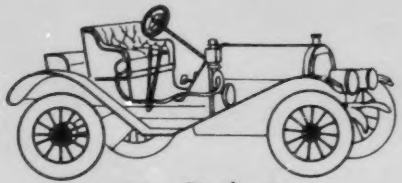
C. Performs most work indoors

D. Is required to stoop, bend, crawl, and lift heavy objects

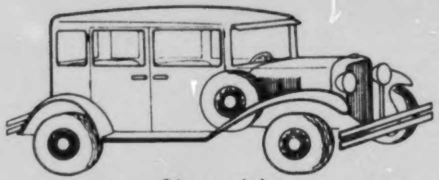
E. Earnings vary according to employer and section of the country.

1. Evolution of the Automotive Industry
2. Careers of the trade
    a. designing
    b. welding
    c. assembly line
    d. painting
    e. maintenance

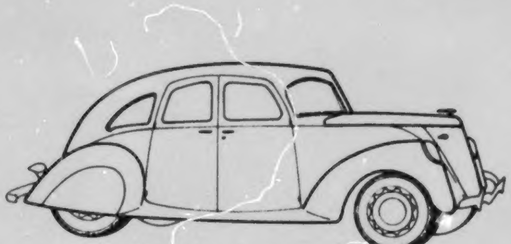
EVOLUTION OF THE AUTOMOBILE INDUSTRY



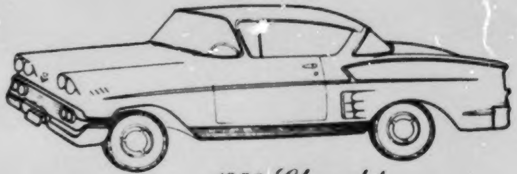
1908 Packard



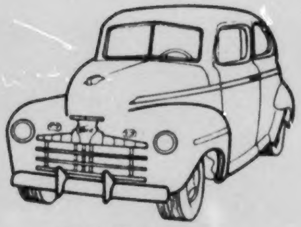
1929 Oldsmobile



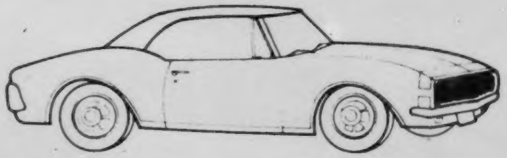
1935 Lincoln-Zephyr



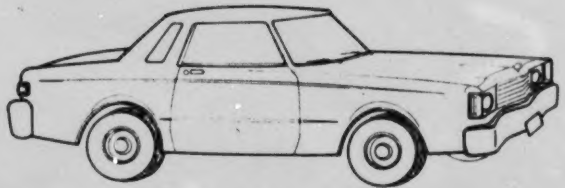
1958 Chevrolet



1945 Ford

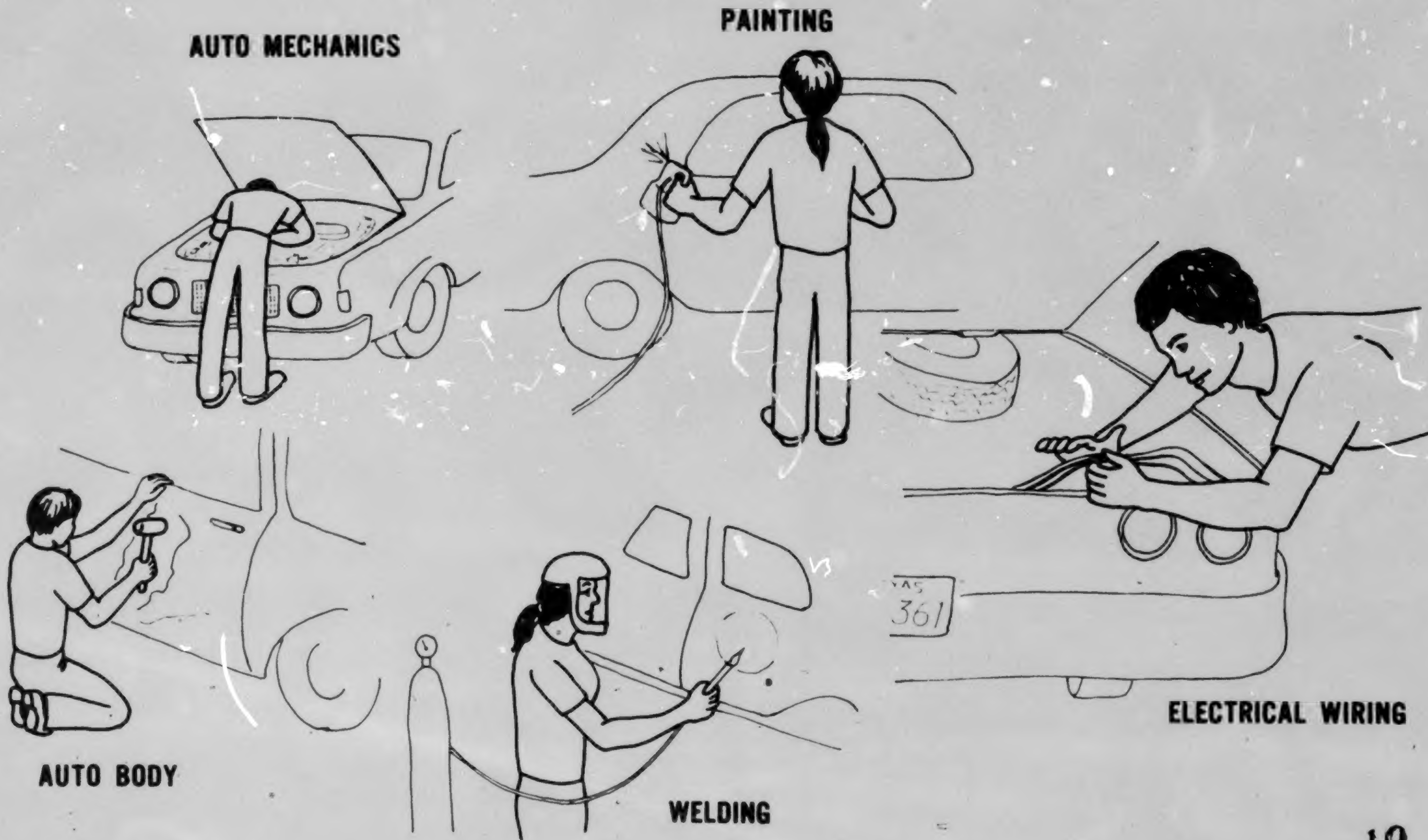


1967 Chevrolet Camaro



1977 Ford Granada

CAREERS OF THE TRADE


AUTO MECHANICS
PAINTING
ELECTRICAL WIRING
AUTO BODY
WELDING

TM-2

I-11

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

ASSIGNMENT SHEET #1--LOCATE INFORMATION ABOUT THE LOCAL JOB MARKET

Directions: Prepare a display of materials in loose-leaf form. Include a list of places employing automotive people, newspaper or magazine articles with a write up describing the article, and a list of job opportunities in the automotive industry from any newspaper. Arrange these in any logical order.

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

ASSIGNMENT SHEET #2--INTERVIEW A MANAGER OF AN AUTOMOTIVE BUSINESS

Directions: Interview a person who works in or is manager of an automotive business. Collect information such as place of work, years of experience, yearly salary, starting salaries, work-week hours, benefits, equipment or tools required, and knowledge needed.

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

UNIT TEST

1. Match the invention to the correct person listed on the right.

    _____a. First four-cycle engine

    _____b. First practical engine using an electrical spark produced by an induction coil

    _____c. First successful four-stroke engine

    _____d. First gasoline engine with carburetor

    _____e. Gas engine with a constantly lighted flame outside the engine

    _____f. Engine using a mixture of gas and air produced by a second pump

    _____g. First reciprocating engine which used gunpowder

    1. Christian Huggens
    2. Samuel Brown
    3. William Barnett
    4. Pierre Lenoir
    5. Beau DeRochas
    6. Dr. N.A. Otto
    7. Gottlieb Daimler

2. List five careers found in the auto industry.

    a.

    b.

    c.

    d.

    e.

3. What are four duties of the auto mechanic?

    a.

    b.

    c.

d.

4. Demonstrate the ability to:

   a. Locate information on the local job market.

   b. Inquire about the nature of work involved at a place of business employing automotive people.

   (Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT I

INTRODUCTION TO MINOR AUTOMOTIVE MAINTENANCE

ANSWERS TO TEST

1. 5 a.

   4 b.

   6 c.

   7 d.

   2 e.

   3 f.

   1 g.

2. a. designing

   b. welding

   c. assembly line work

   d. painting

   e. maintenance

3. Four of the following:

   a. repairing automotive systems

   b. adjusting automotive systems

   c. uses hand tools and testing equipment

   d. installs accessories

   e. servicing the automobile

4. Evaluated to the satisfaction of the instructor

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

UNIT OBJECTIVES

After completion of this unit, the student will be able to identify safety and point out unsafe practices in the automotive shop. The student will participate in safety operations and practices. This knowledge will be evidenced through demonstration and by scoring 100% on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Define safety and list the general areas it involves.
2. Select the proper safety attitudes for an automotive shop.
3. Determine the ways personal safety affects the individual.
4. List four ways group safety can be made effective.
5. Decide which clothing rules are correct for the automotive shop.
6. Determine the correct safety rules for hand tools.
7. Identify the correct safety rules involving the use of power tools.
8. Point out the correct use of jack stands.
9. Demonstrate the ability to:
    a. Organize safety ideas into a safety poster.
    b. Inspect the shop for safety features.
    c. Safely place a car on jack stands.

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheet.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and assignment sheets.

   F. Provide student with job sheet.

   G. Give and evaluate test.

   H. Review questions missed on test.

II. Student

   A. Read objective sheet.

   B. Study and discuss information sheet.

   C. Complete each assignment sheet.

   D. Demonstrate safety procedures on job sheet.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM-1--Horseplay in the Shop

      2. TM-2--Recognize Unsafe Conditions

3. TM-3--Fire Prevention
4. TM-4--Lifting and Blocking
5. TM-5--Proper Ventilation
6. TM-6--Proper Clothing
7. TM-7--Air Hose Safety
8. TM-8--Eye and Face Protection
9. TM-9--Acids
10. TM-10--Driving in the Shop

D. Assignment sheets

1. Assignment Sheet #1--Organize Safety Ideas Into a Safety Poster
2. Assignment Sheet #2--Inspect the Shop for Safety Features

E. Job Sheet--Safely Place a Car on Jack Stands

F. Test

G. Answers to test

II. References

A. Glenn, Harold T. Exploring Power Mechanics. 2nd ed. Peoria, Illinois: Charles A. Bennett Co., Inc., n.d.

B. Shop Safety. Elmore, Alabama: Rehabilitation Research Foundation, 1966.

C. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1974.

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

INFORMATION SHEET

I. Safety defined

- A. Freedom from accidents
- B. Includes general safety involving:
    - 1. Attitudes
    - 2. Personal safety
    - 3. Group safety
    - 4. Protective clothing
    - 5. Use of tools and equipment

II. Attitudes

- A. Proper attitudes are a must in every automotive shop.
- B. Most accidents are caused by a person being thoughtless.
- C. Each person must be on guard at all times against accidents.
- D. Visiting during work should be avoided as it distracts from one's alertness to prevent accidents.

III. Personal Safety

- A. This involves protecting yourself from injury caused by your own or others' actions.
- B. Be aware of unsafe conditions and practices.
- C. Protect others by practicing safety.

IV. Group Safety

- A. Includes all of your class
- B. Every person's actions could have a reaction on you.

C. Stress shop safety to your buddy.

D. Never participate in horseplay.

V. Protective Clothing

A. A person must decide what clothing is proper in different shop situations.

B. Clothing should always be as nearly fireproof as possible.

C. Proper clothing involves keeping it clean and free from frayed edges.

D. Wear proper eye protection for the occasion.

VI. Hand Tools

A. These can be dangerous to hands, eyes, and limbs.

B. Proper use and care can make your job easier as well as safer.

C. Proper handling includes:

1. Never throwing tools
2. Pulling on wrenches, not pushing
3. Keeping tools off of the floor
4. Carrying tools with sharp points down
5. Repairing loose handles immediately
6. Using striking tools (hammers) carefully
7. Making sure wrenches fit properly

VII. Power Tools

A. Always wear eye protection.

B. Wear proper clothing.

C. Keep abrasive stones tight, clean, and true.

D. Allow power tools to reach full RPM before using.

E. Keep grinder tool rest as close as possible to the grinding wheel.

F. Stand to one side when grinding.

G. Be aware of others around you.

H. Wipe up spills promptly.

I. Unplug cords before making adjustments or changing grinding wheels, bits, or other equipment parts.

J. Never use power tools while you are wearing wet shoes or standing in water.

K. Secure work to be drilled.

L. Alert others when hot materials are lying around.

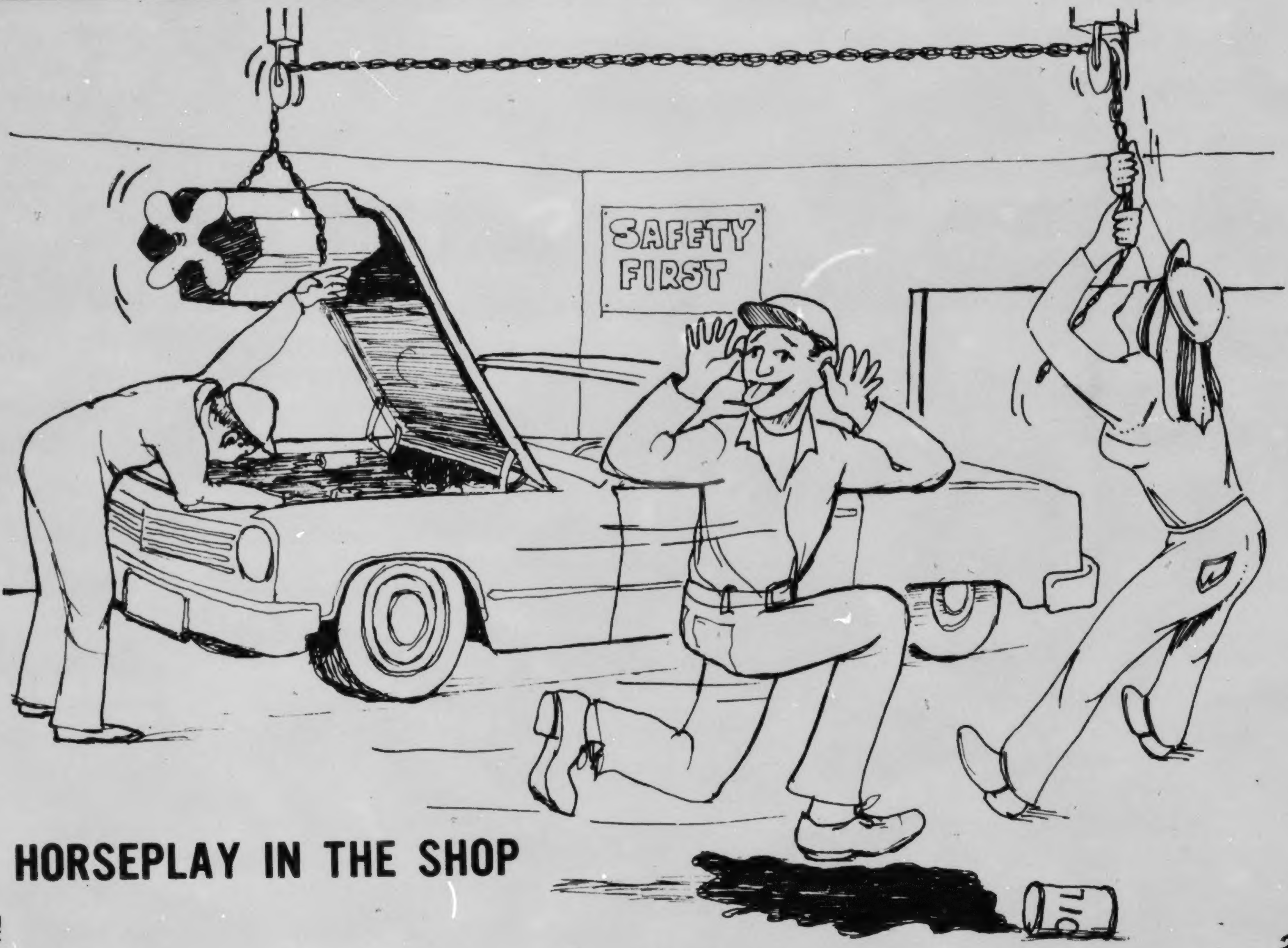
VIII. Use of jack stands

A. Use jack stands when placing an automobile on a jack or when working under an automobile.

B. Place stands in a secure position under the automobile.

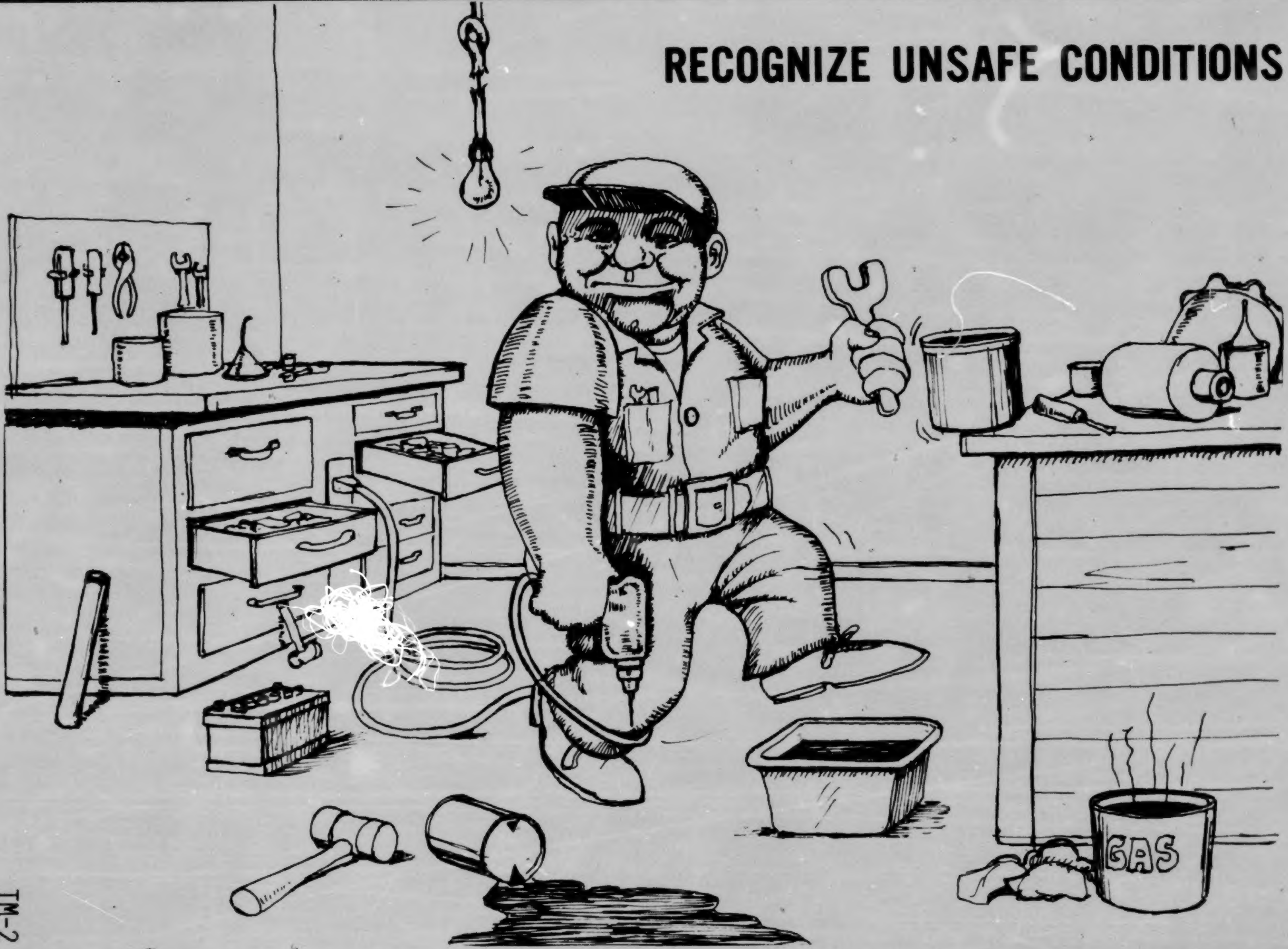
C. Use adequate lighting when placing stands under automobiles.

D. Release the jack slowly, allowing the automobile to easily rest on stands.


SAFETY FIRST
OIL

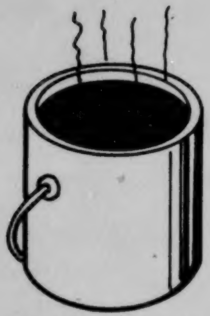
HORSEPLAY IN THE SHOP

RECOGNIZE UNSAFE CONDITIONS

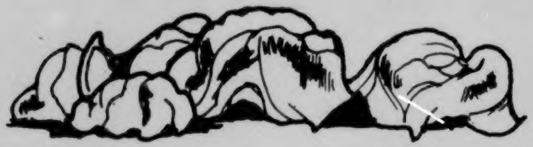


FIRE PREVENTION

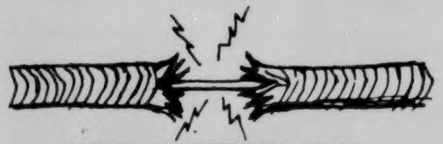
Dangerous Conditions



OPEN CAN OF GASOLINE (CAUSES EXPLOSIONS)

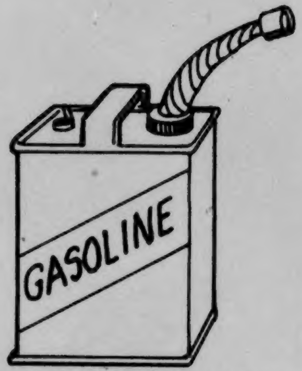


GREASY RAGS AND WASTE (CAUSE SPONTANEOUS COMBUSTION)

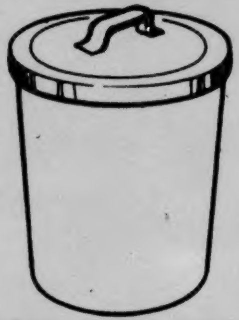


NAKED ELECTRICAL WIRE (CAUSES ELECTRICAL FIRES)

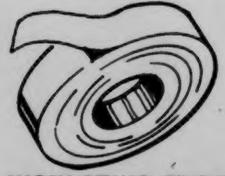
Remedies



APPROVED SAFETY CAN

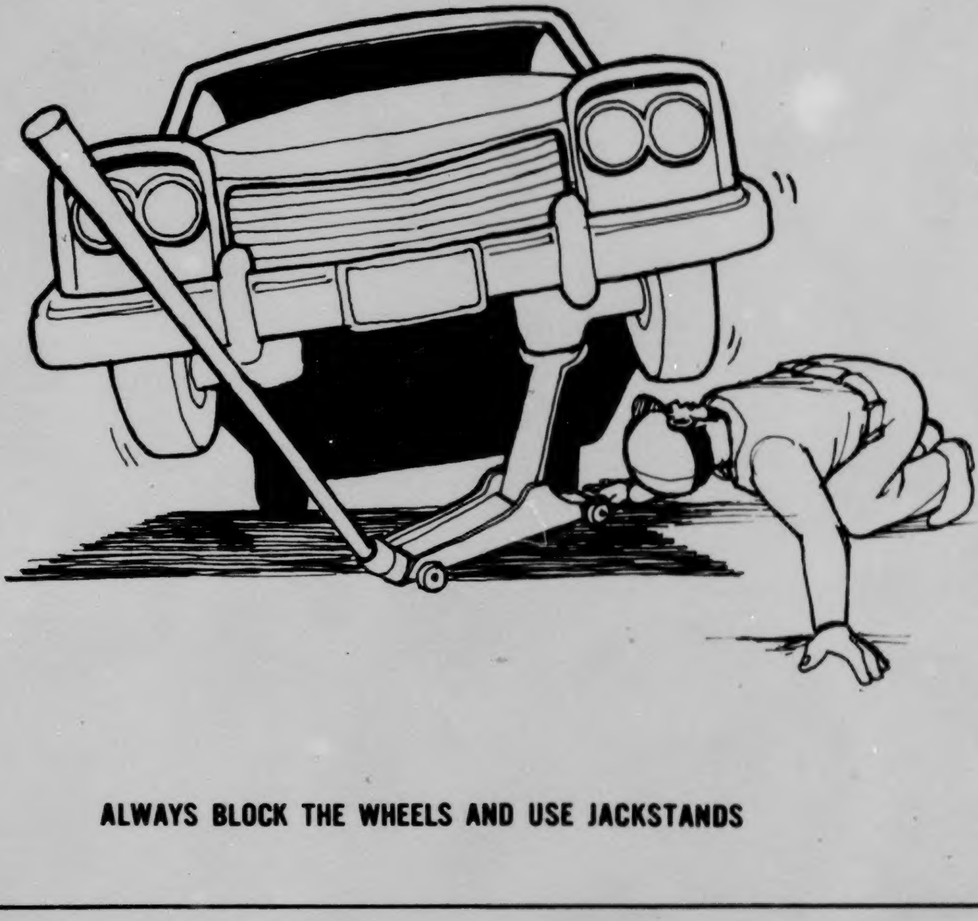


COVERED METAL CONTAINER

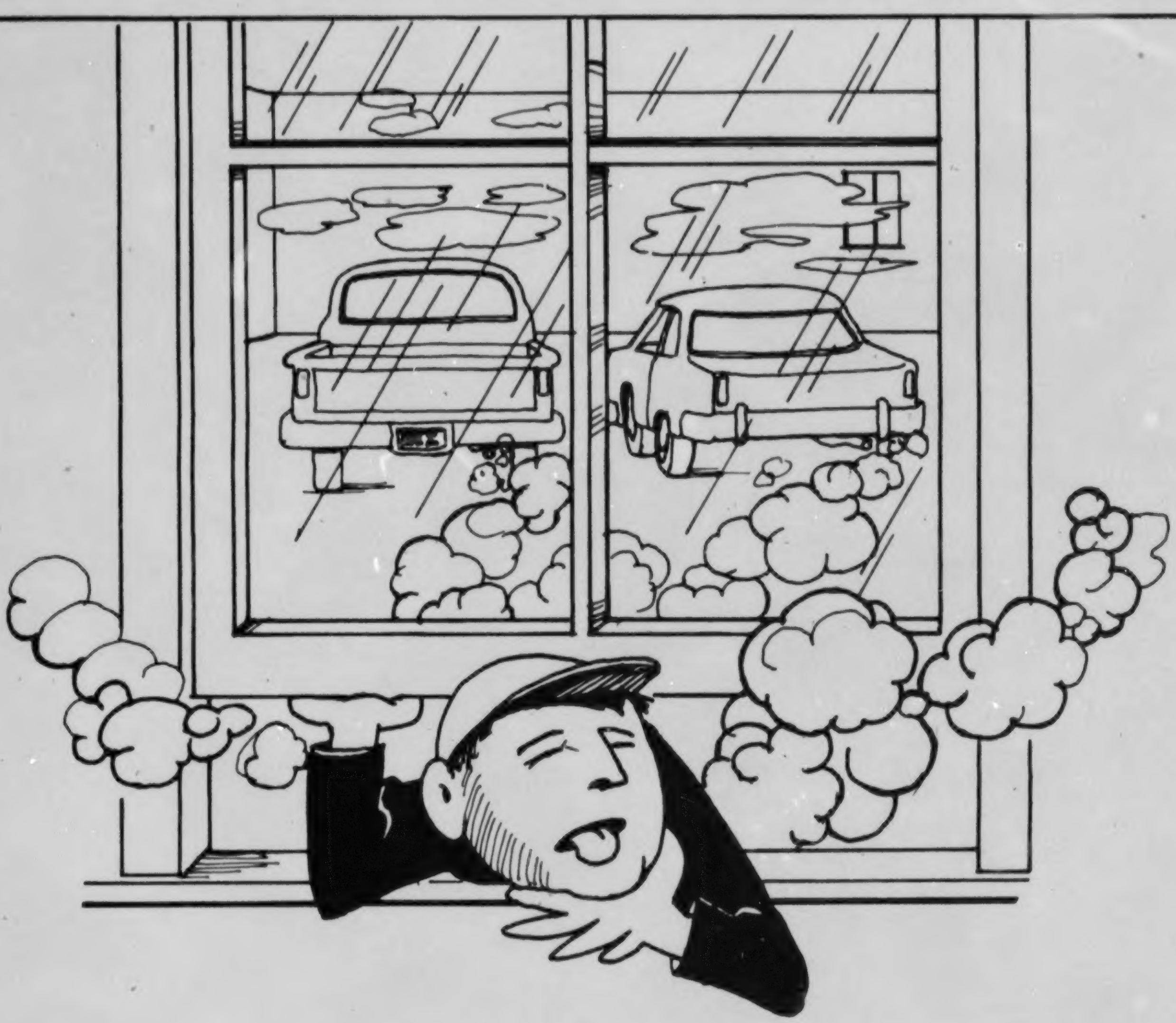


INSULATING TAPES

LIFTING AND BLOCKING



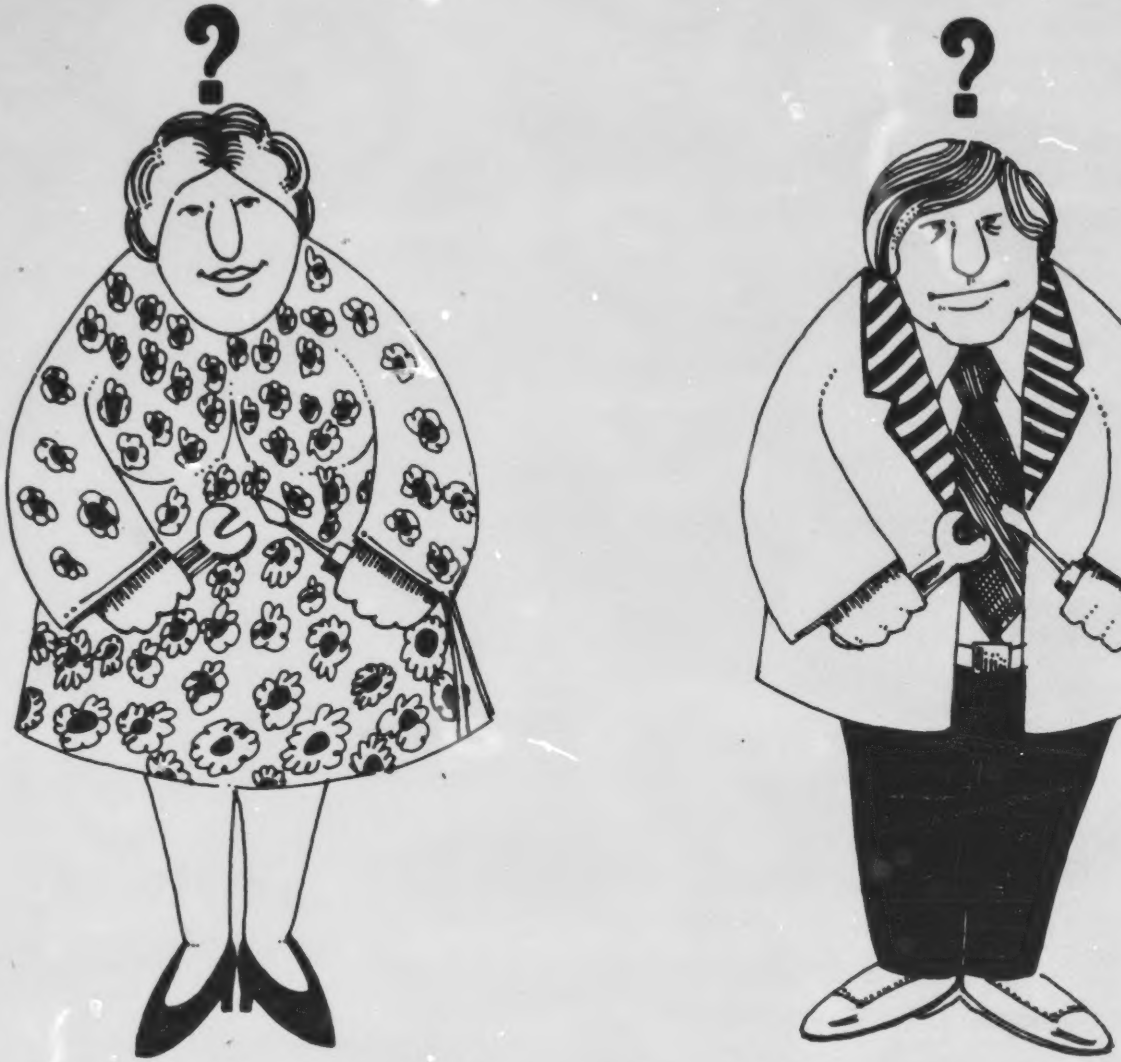
ALWAYS BLOCK THE WHEELS AND USE JACKSTANDS



PROPER VENTILATION

TM-5

II-17

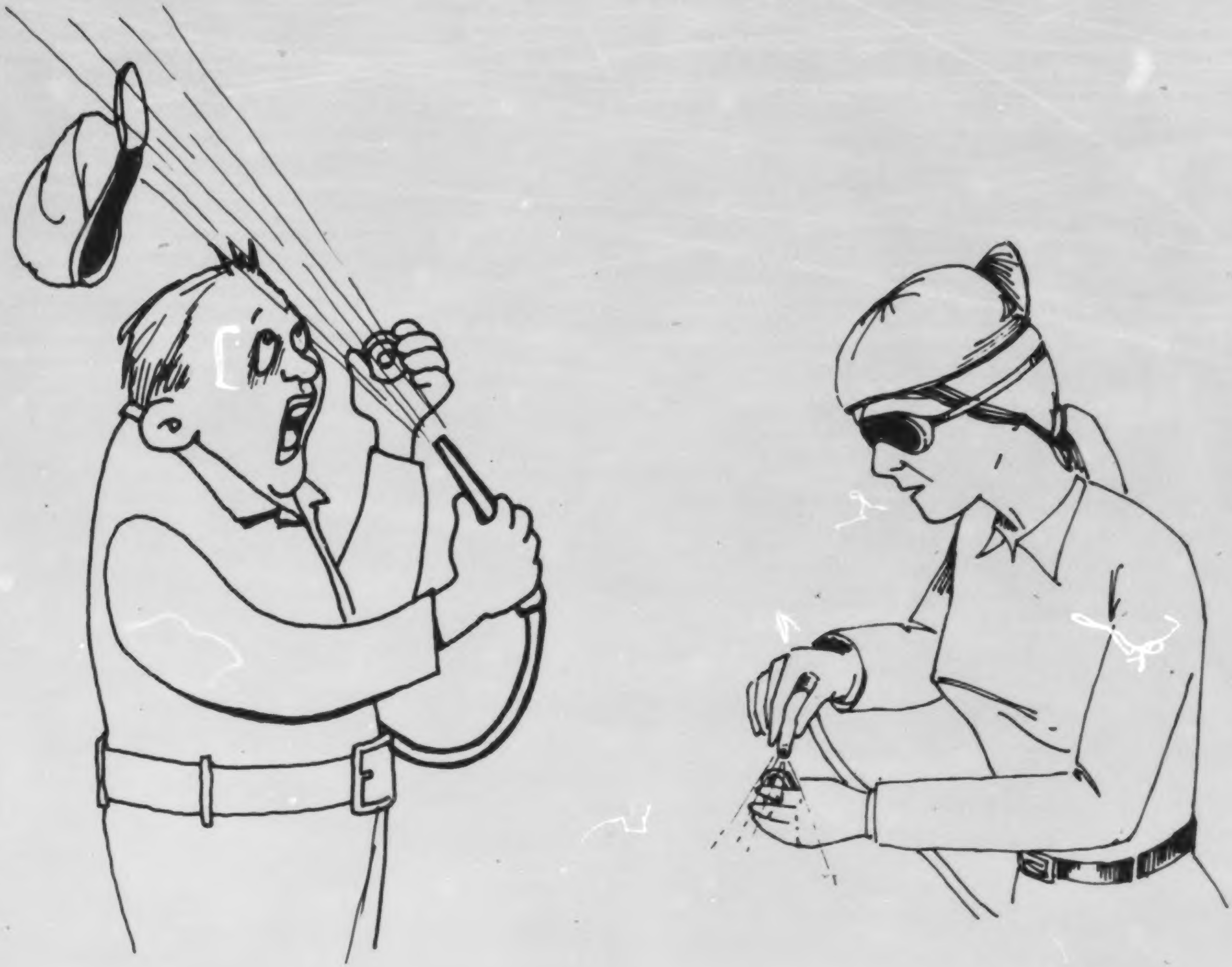


PROPER CLOTHING

TM-6

II-19

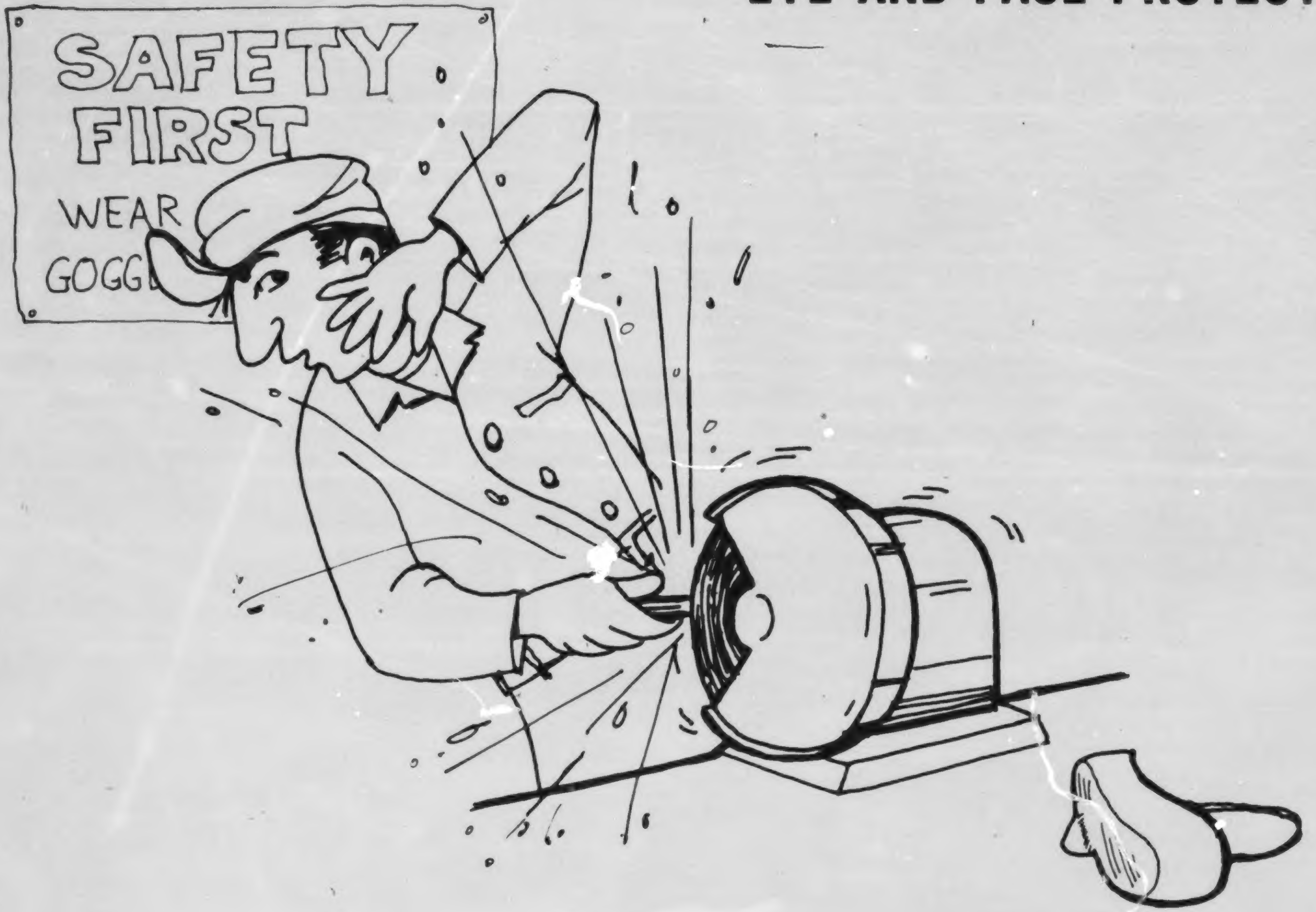
AIR HOSE SAFETY

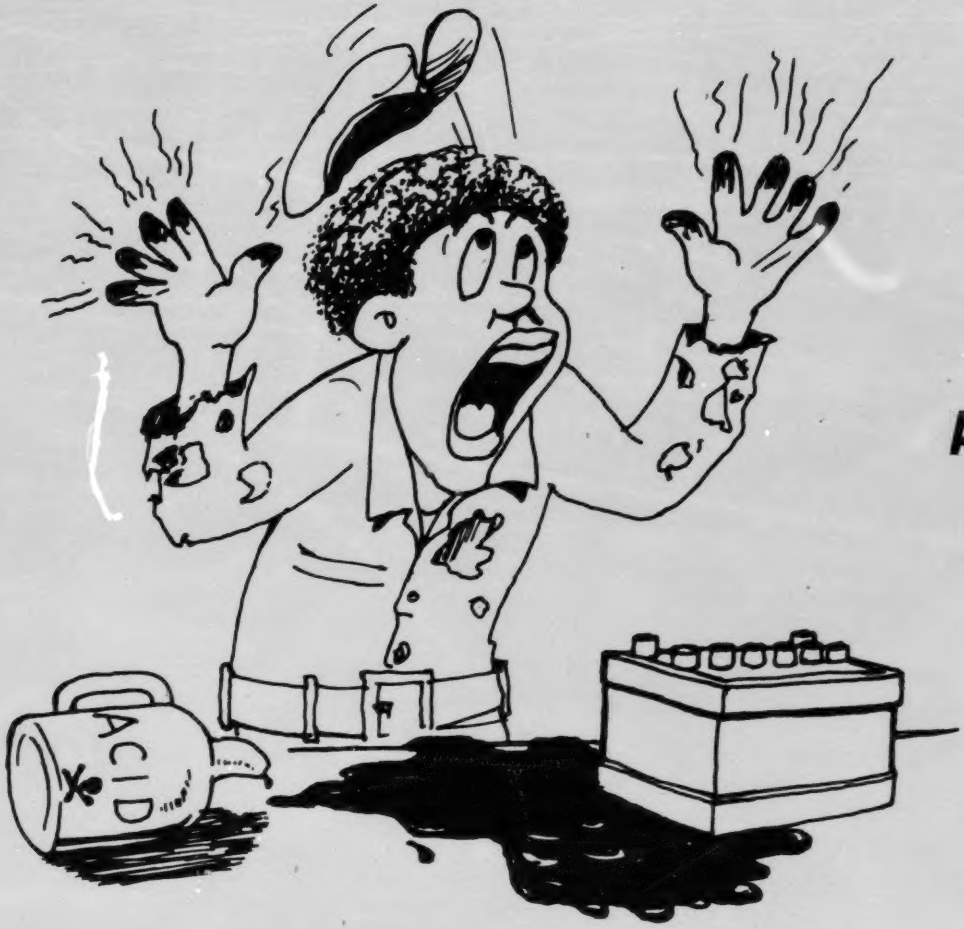


TM-7

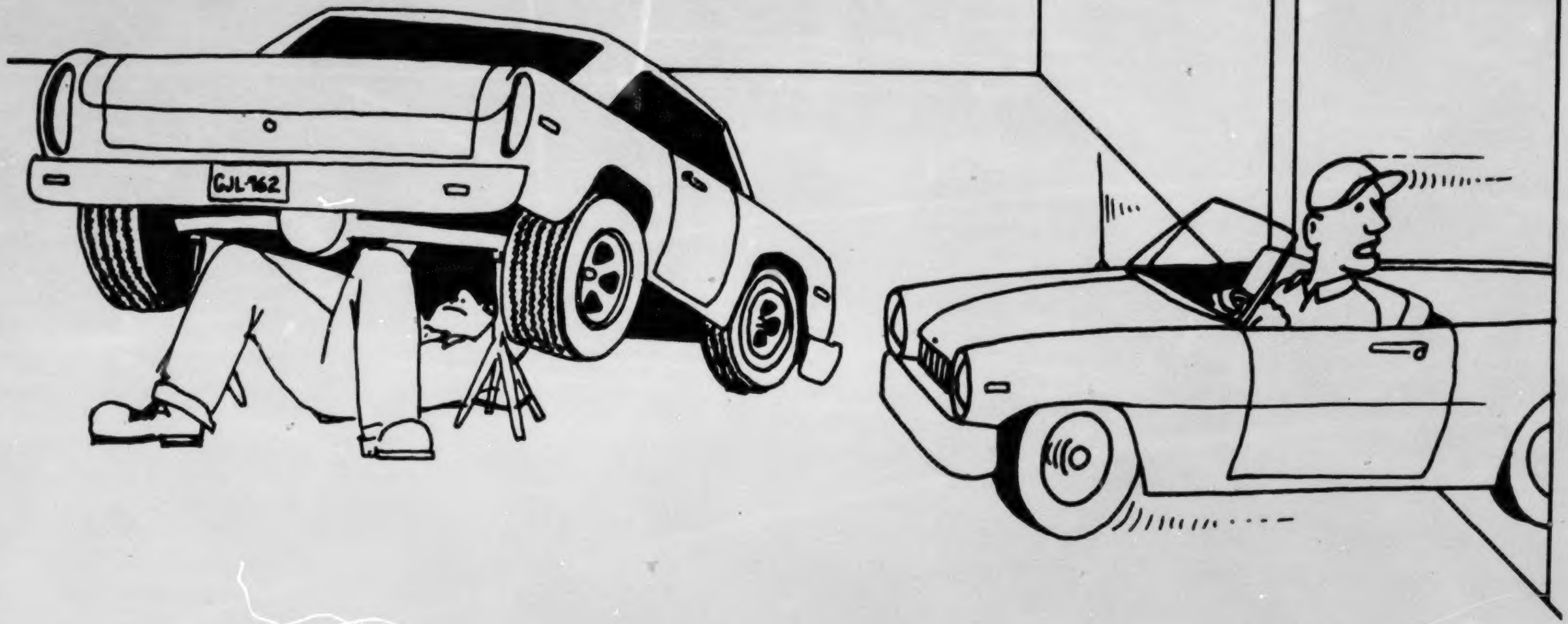
II-21

EYE AND FACE PROTECTION


SAFETY
FIRST
WEAR
GOGG



ACIDS



DRIVING IN THE SHOP.

TM-10

II-27

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

ASSIGNMENT SHEET #1--ORGANIZE SAFETY IDEAS INTO A SAFETY POSTER

Directions: Prepare a safety poster on a large piece of cardboard or paper (approximately 20 inches by 30 inches). Illustrate accidents, prevention of accidents, safe use of materials, or safe use of equipment on the poster. Create any unusual idea that would help in making safety a part of shop operations.

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

ASSIGNMENT SHEET #2--INSPECT THE SHOP FOR SAFETY FEATURES

Directions: Check the shop for any unsafe feature, using the list below. Rate each area by circling one of the following ratings:
S - Satisfactory
A - Acceptable (needs some attention)
U - Unsatisfactory (needs immediate attention)

Make suggestions for correcting any areas rated "U" by writing them on the suggestion sheet.

1. Machines, benches, and other equipment are arranged to permit good safety practices. S A U
2. Condition of aisles between equipment S A U
3. Condition of floors S A U
4. Condition of walls, windows, and ceilings S A U
5. Sufficient lighting S A U
6. Ventilation S A U
7. Fire extinguishers are the proper type, in the proper place, and ready to use. S A U
8. Class members know how to use fire-fighting materials. S A U
9. Exits are properly marked. S A U
10. A fire escape plan is posted by each door. S A U
11. Tools are properly stored. S A U
12. Materials and scraps are properly stored. S A U
13. Dangerous or flammable materials are properly stored. S A U

14. Danger zones are properly marked and guarded. S A U

15. Color coding is correct on switches and moving parts. S A U

16. All switches are easily available to the operator. S A U

17. Cleaning brushes are available. S A U

18. Machines are in safe working condition. S A U

19. Tools are cleaned and sharpened, ready for use. S A U

20. All hoisting devices are in safe operating condition. S A U

21. All extension cords and other wiring are in good condition. S A U

22. All gas fittings and fixtures are in good shape. S A U

23. Goggles or protective shields are provided. S A U

24. Eye protection is being used properly. S A U

25. Safety rules are posted at each danger station. S A U

26. Safety posters are displayed. S A U

27. Safety posters have been changed regularly. S A U

28. Accident records are kept. S A U

29. A stocked first-aid cabinet is available. S A U

30. Someone has been designated to take care of first aid in case of an accident. S A U

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

JOB SHEET #1--SAFELY PLACE A CAR ON JACK STANDS

I. Equipment required

- A. A 2-ton hydraulic jack
- B. Four jack stands
- C. An automobile

II. Procedure

(Caution: When placing jack or jack stands under car, use proper lighting. Place the stands securely so they will not damage any part of the car, and will not fall on the mechanic.)

- A. Place jack under front end of car in a safe, stable place.

  (Note: The frame of a car is usually the most secure place.)

- B. Raise car to desired height.
- C. Place jack stands (2) in proper location.
- D. Release jack slowly, allowing front of car to rest on jack stands.
- E. Follow same procedure at rear of car.

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

UNIT TEST

1. Define safety and list the general areas it involves.

2. Select the proper safety attitudes for an automotive shop by circling the letter in front of each.

   a. Take your safety attitudes with you to every automotive shop.

   b. Do not be thoughtless because this causes most accidents.

   c. Be on guard against accidents when you are the only one working.

   d. Visit others in the shop while working because two people can be more alert to accidents.

3. Determine the ways personal safety affect the individual by underlining the correct answer in each statement.

   a. Personal safety involves protecting (machinery, yourself) from injury caused by your own or others' actions.

   b. Personal safety involves being aware of (unsafe, safe) conditions and practices.

   c. Personal safety involves (protecting, staying away from) others by practicing safety.

4. List four ways group safety can be made effective.

   a.

   b.

   c.

   d.

5. Decide which clothing rules are correct for the automotive shop by answering true or false to each of the following:

____a. The same clothing can be worn in all shop situations.

____b. Since there are very few fires in the automotive shop, clothing need not be fireproof.

____c. Clothing cannot be kept clean in the automotive shop because the shop is too greasy.

____d. Wearing safety glasses does not apply to automotive shops.

6. Determine the correct safety rules for hand tools by answering true or false for each of the following:

____a. Hand tools are small, easily concealed, and never dangerous.

____b. Proper use and care can make your job easier as well as safer.

____c. Tools should be thrown or tossed to the tool clerk to speed clean-up.

____d. Pull on wrenches, but never push.

____e. When leaving tools on the floor, put them in neat piles.

____f. Carry tools with points up so you will not punch holes in your clothes or legs.

____g. Repair loose handles at the end of the day so time will not be wasted during work.

____h. Use hammers and other striking tools carefully.

____i. Wrenches should fit loosely so they may be quickly removed.

7. Identify the correct safety rules involving the use of power tools by answering yes or no to each of the following:

____a. Always wear eye protection.

____b. Wear proper clothing.

____c. Don't tighten abrasive stones because they will crack.

____d. Power tools should not reach full RPM because they will burn up.

____e. Keep the grinding tool rest as close as possible to the grinding wheel.

____f. Stand directly in front of the grinder when grinding.

____g. Be aware of others around you.

____h. Wipe up spills promptly.

____i. Make adjustments on tools before unplugging the cord.

____j. Never use power tools while wearing wet shoes or standing in water.

____k. Leave stock loose when drilling.

____l. Alert others when hot materials are lying around.

8. Point out the correct use of jack stands by circling the correct answer for each of the following.

   a. Use (a jack only, a jack and jack stands) when working on an automobile.

   b. Place stands (in a secure position, anywhere convenient) under the automobile.

   c. Use (gloves, adequate lighting) when placing stands under automobile.

   d. Release the jack (slowly, quickly), allowing the automobile to easily rest on the stands.

9. Demonstrate the ability to:

   a. Organize safety ideas into a safety poster.

   b. Inspect the shop for safety features.

   c. Safely place a car on jack stands.

(Note: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT II

MINOR AUTOMOTIVE SHOP SAFETY

ANSWERS TO TEST

1. Safety is defined as freedom from accidents. It involves attitudes, personal safety, group safety, and use of tools and equipment.

2. a.

   b.

3. a. yourself

   b. unsafe

   c. protecting

4. a. Group safety must include the whole class.

   b. Be aware that every person's actions could be a reaction on you.

   c. Stress shop safety to your buddies.

   d. Never participate in horseplay.

5. False a.

   False b.

   False c.

   False d.

6. False a.

   True b.

   False c.

   True d.

   False e.

   False f,

   False g.

   True h.

False i.

7. yes a.

yes b.

no c.

no d.

yes e.

no f.

yes g.

yes h.

no i.

yes j.

no k.

yes l.

8. a. a jack and jack stand

b. in a secure position

c. adequate lighting

d. slowly

9. Evaluated to the satisfaction of the instructor

UNIT III

ENGINE PRINCIPLES

UNIT OBJECTIVE

After completion of this unit, the student will be able to define all major engine parts and discuss their relationship to one another. The student will be able to discuss the four strokes of a four-cycle engine to include the interrelationship of the crankshaft, pistons, rods, valves, and bearings. This knowledge will be evidenced by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the combustion engine.
2. Point out the differences in the internal- and external-combustion engines.
3. Match the terms associated with the combustion engine with the proper explanation.
4. Point out the function of each of the parts of the valve train.
5. Determine the function of each type of ring used on the piston.
6. Determine the functions of a flywheel.
7. Identify the three elements necessary to cause an explosion in the cylinder.
8. Arrange the functions for starting an engine in the proper order.
9. Match each of the strokes to the function of the four-stroke cycles of a gasoline engine.
10. Arrange the events of a power sequence in order.

UNIT III

ENGINE PRINCIPLES

SUGGESTED ACTIVITIES

I. Instructor

- A. Provide student with objective sheet.
- B. Provide student with information sheet.
- C. Discuss terminal and specific objectives.
- D. Review information sheet.
- E. Explain transparencies.
- F. Give and evaluate test.
- G. Review questions missed on test.

II. Student

- A. Read objective sheet.
- B. Study information sheet.
- C. Orally interpret transparencies.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheets
  - 1. Information Sheet #1--The Parts of the Engine and How They Work
  - 2. Information Sheet #2--The Engine in Motion
- C. Transparencies
  - 1. TM-1--Internal and External Combustion
  - 2. TM-2--Engine (Cutaway View)
  - 3. TM-3--Four-Stroke Cycle Engine

    4. TM-4--Crankshaft and Flywheel
    5. TM-5--Rod
    6. TM-6--Piston and Rings
    7. TM-7--Valve
    8. TM-8--Valve Train
    9. TM-9--Camshaft
    10. TM-10--Bearing Types

D. Test

E. Answers to test

II. References

A. Atteberry, Pat H. Power Mechanics. Homewood, Illinois: Goodheart-Wilcox Company, Inc. Publishers, 1961.

B. Stephenson, George E. Power Technology. Albany, New York: Delmar Publishers, Inc., 1968.

UNIT III

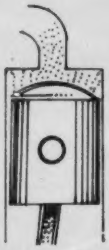
ENGINE PRINCIPLES

INFORMATION SHEET #1--THE PARTS OF THE ENGINE AND HOW THEY WORK

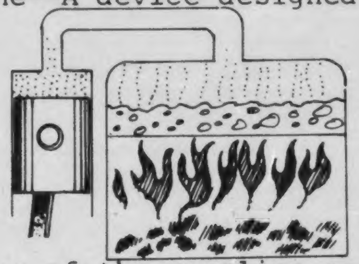
I. The purpose of the combustion engine is to convert raw materials such as gasoline into mechanical power to do the many work-related jobs needed by man.

II. Types of combustion engines

A. Internal-combustion engine--A devide used to burn raw materials within itself



B. External-combustion engine--A device designed to accept the pressure of raw materials being burned in another container and then forced into the engine



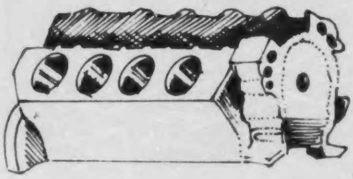
III. Part definitions and functions of the gasoline engine

A. Block

1. Main framework of the piston engine

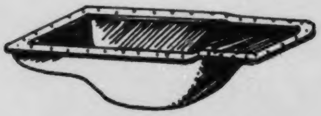
2. Houses internal parts

3. Provides a place to mount external parts



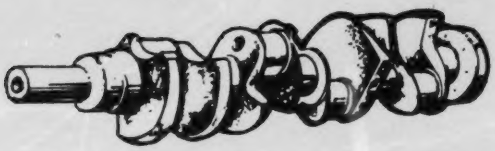
B. Crankcase

1. The housing within which the crankshaft and other engine parts operate
2. Contains the oil for lubrication of the engine
3. Also known as oil pan



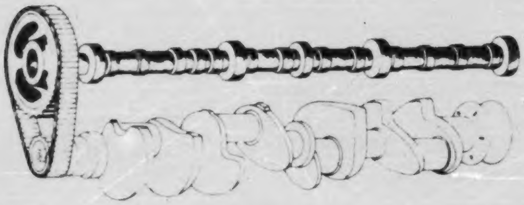
C. Crankshaft

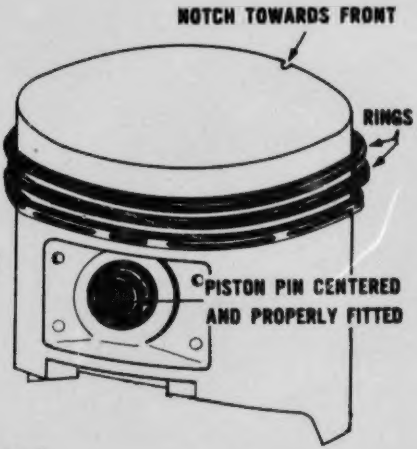
1. The main shaft running through the engine
2. Converts the up and down motion of the piston to usable rotary power



D. Camshaft

1. Contains lobes or cams
2. Opens engine valves





E. Piston

1. A round part closed on one end

2. Installed in a cylinder hole

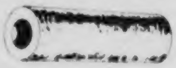
3. Attached to a connecting rod

4. Transfers force of explosion to a connecting rod

F. Ring--A flexible piece of metal used to seal the piston to the cylinder walls during the power and compression stroke.

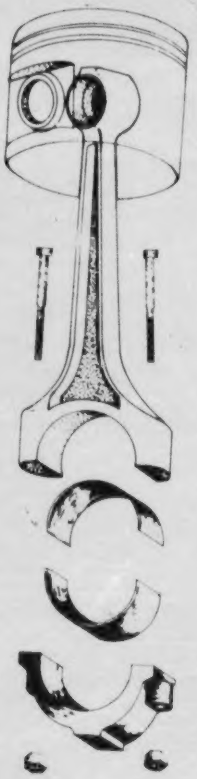
G. Piston pin

1. The journal for the bearing in the small end of the connecting rod



2. Connects the rod to the piston

3. Also known as a "wrist pin"



H. Piston boss--The part of the piston through which the piston pin is inserted

I. Piston skirt--The lower part of the piston

J. Connecting rod

1. A shaft connecting the piston to the crankshaft

2. Transfers the force of the explosion from the piston to the crankshaft

K. Bearing

1. A replaceable, load-carrying part

2. Cuts down on friction and wear

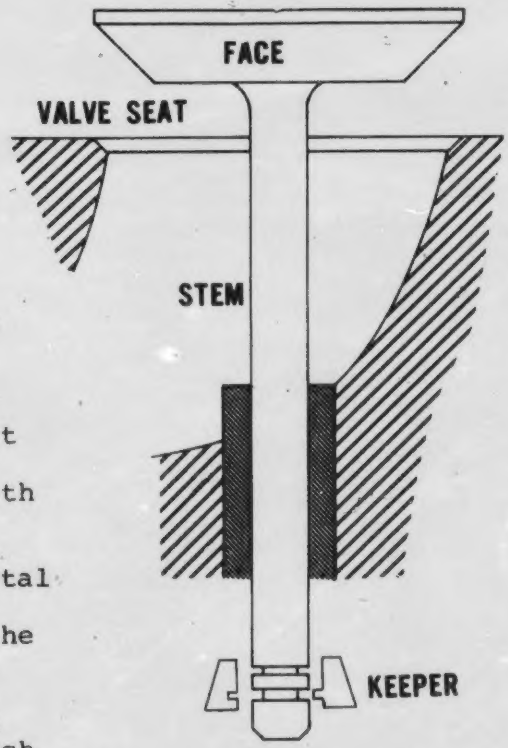
3. Main and insert bearings are used on the crankshaft

L. Valve

1. A device used to open or close an opening

2. Allows fuel to come into the cylinder

3. Allows burned fuel to exhaust out of the cylinder



M. Valve face--The part of the valve that comes in contact with the valve seat.

N. Keeper--Piece of metal used to secure the valve spring onto the valve

O. Valve seat--Area on the engine with which the valve face comes into contact

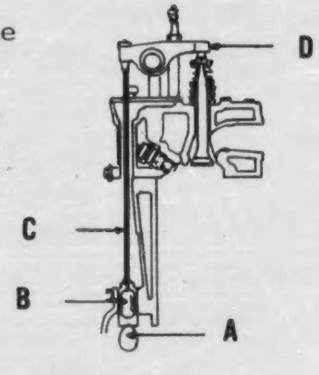
IV. Function of the parts of the valve train

A. Camshaft--The lobes lift the hydraulic lifters

B. Lifter--Raises the pushrods

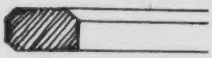
C. Pushrod--Pushes the rocker arm

D. Rocker arm--Pushes the valve open

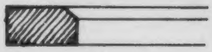


V. Function of the types of rings

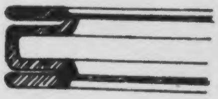
A. Compression ring--Seals the piston within the cylinder and prevents explosion "blow by"



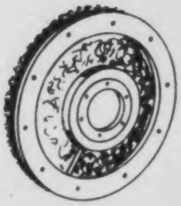
B. Wiper ring--Wipes the oil off the cylinder wall back into the oil pan on the downward movement of the piston



C. Oil ring--Applies oil to the cylinder wall on the upward stroke of the piston



VI. Functions of the flywheel



A. Acts as a balance to smooth the engine

B. Provides a starter gear

C. Acts as a centrifugal wheel to carry the engine to the next stroke

UNIT III

ENGINE PRINCIPLES

INFORMATION SHEET #2--THE ENGINE IN MOTION

VII. Elements necessary to cause an explosion in the cylinder

   A. Fire--The spark plug produces a spark to ignite fuel

   B. Fuel--A combustible substance, usually gasoline

   C. Air--Supports combustion of substance

VIII. The things necessary for the starting of a gasoline engine

   A. A method for cranking the engine to start it turning

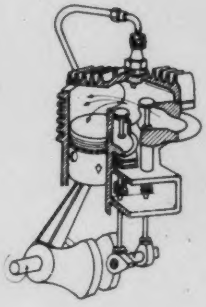
   B. The correct amount of fuel and air mixture

   C. The fuel and air mixture introduced into the cylinder through the intake valve

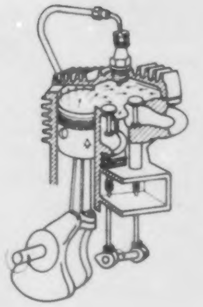
   D. The spark plug must fire near the top of the compression stroke, which explodes the gases and pushes the piston downward.

IX. An explanation of the four-stroke cycles of a gasoline engine

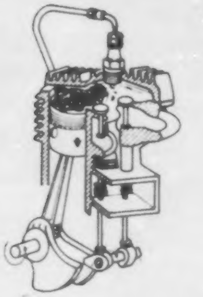
   A. Intake stroke--As the piston moves downward, the intake valves open to be filled with the correct fuel air mixture.



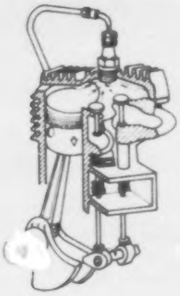
B. Compression stroke--As the piston moves downward, the intake valves open to be filled with the correct fuel-air mixture.



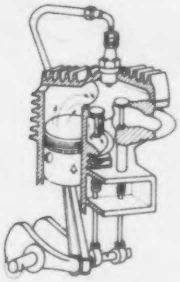
C. Ignition--This action is not considered a stroke, but an event that occurs, causing the fuel-air mixture to explode.



D. Power stroke--The piston begins a downward motion, being forced by expanding burning gases.



E. Exhaust stroke--The piston moves upward as the exhaust valve opens, allowing the burned gases to be forced from the cylinder.



X. Events in a power sequence

(Note: Follow number sequence on drawing.)

A. Explosion over piston

B. Piston drives rod.

C. Rod drives crankshaft.

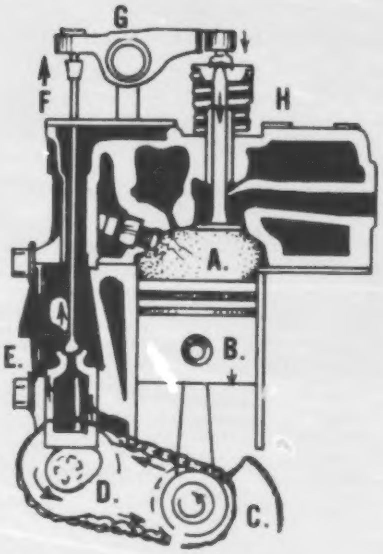
D. Crankshaft drives camshaft.

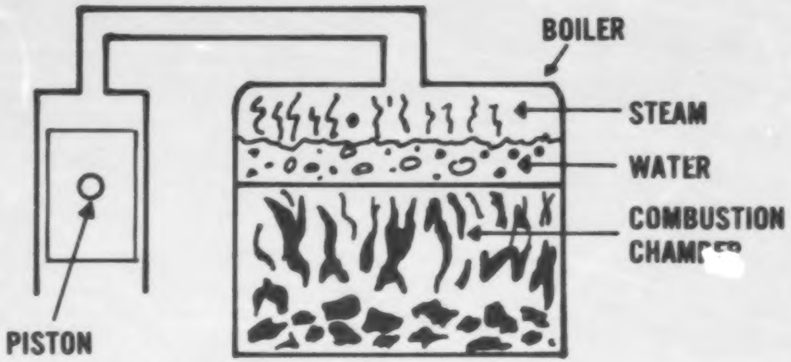
E. Camshaft drives the lifter.

F. Lifter raises the push rod.

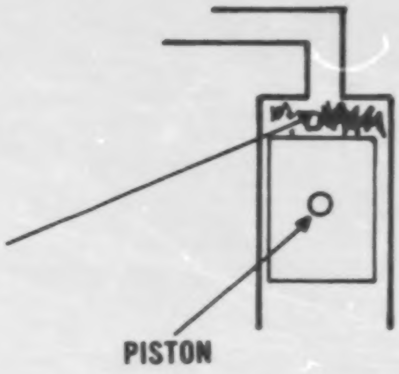
G. Push rod drives the rocker arm.

H. Rocker arm opens valve.




BOILER
STEAM
WATER
COMBUSTION CHAMBER
PISTON

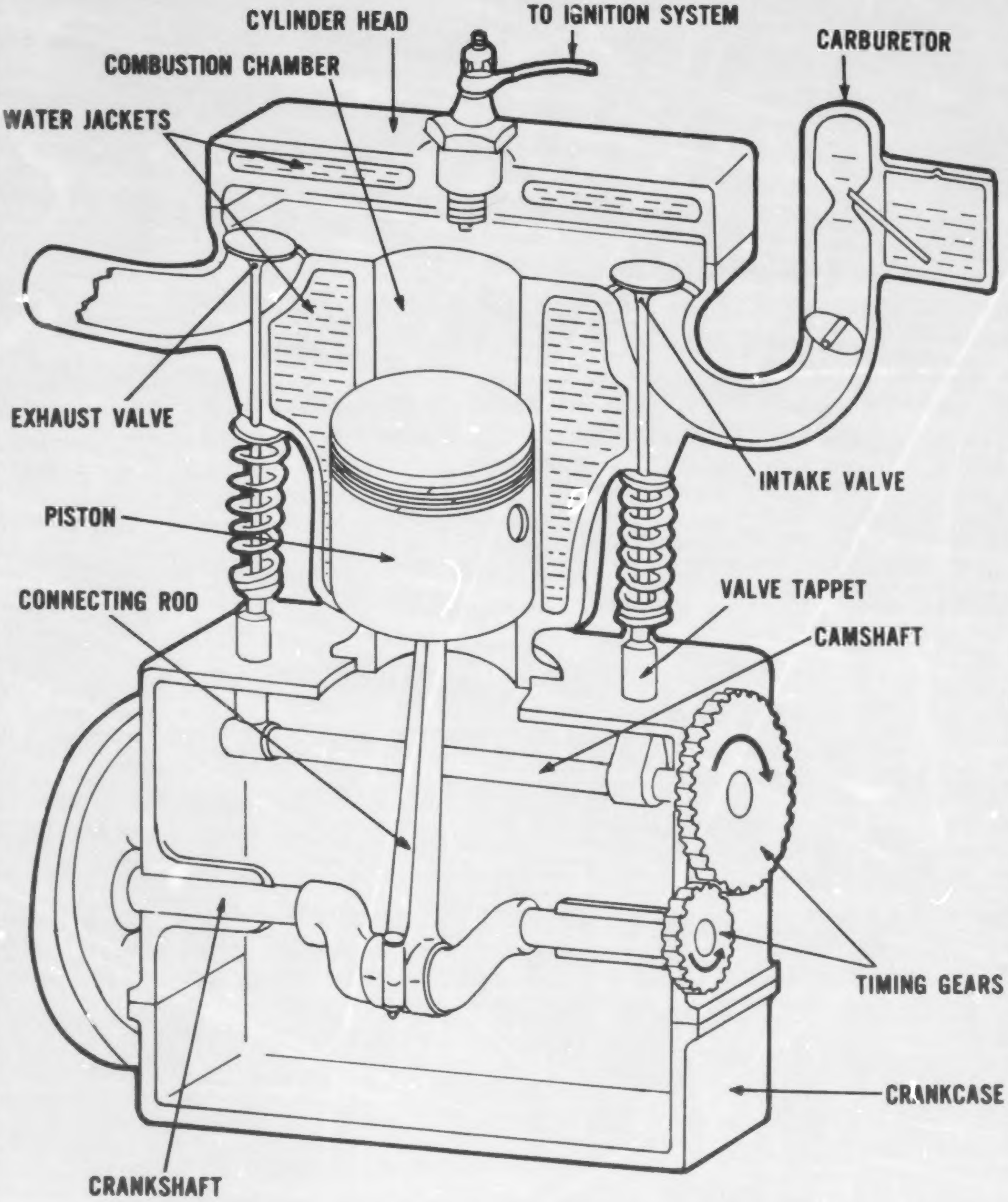
EXTERNAL COMBUSTION



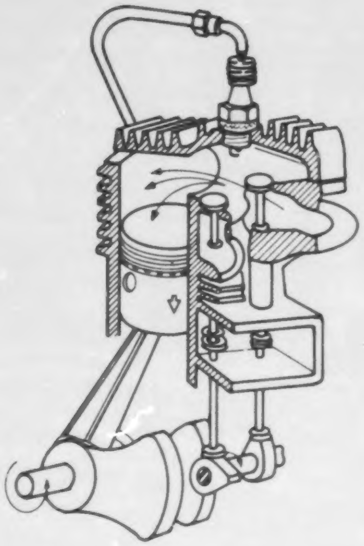
INTERNAL COMBUSTION ENGINE

INTERNAL AND EXTERNAL COMBUSTION

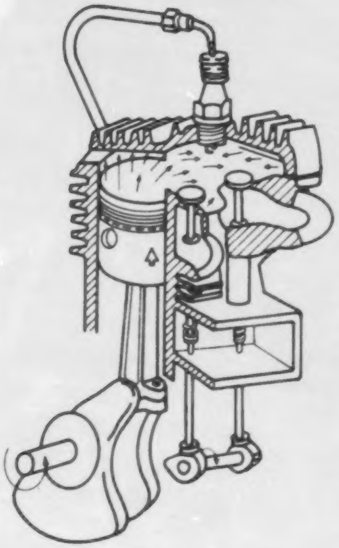
ENGINE (CUTAWAY VIEW)


CYLINDER HEAD
TO IGNITION SYSTEM
CARBURETOR
COMBUSTION CHAMBER
WATER JACKETS
EXHAUST VALVE
INTAKE VALVE
PISTON
CONNECTING ROD
VALVE TAPPET
CAMSHAFT
TIMING GEARS
CRANKCASE
CRANKSHAFT

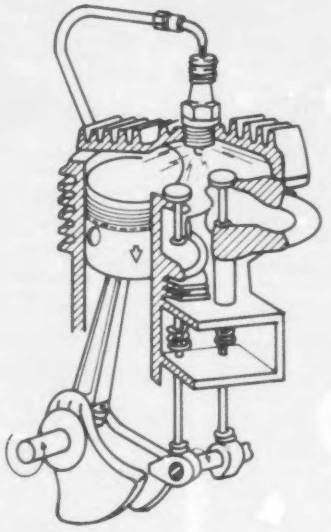
FOUR-STROKE CYCLE



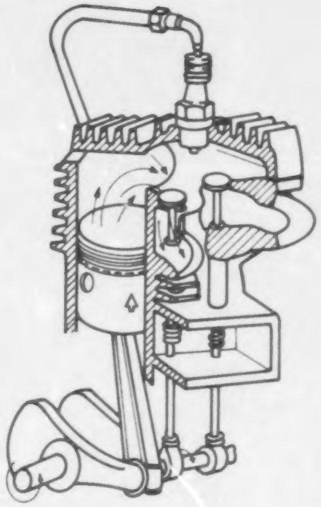
INTAKE



COMPRESSION

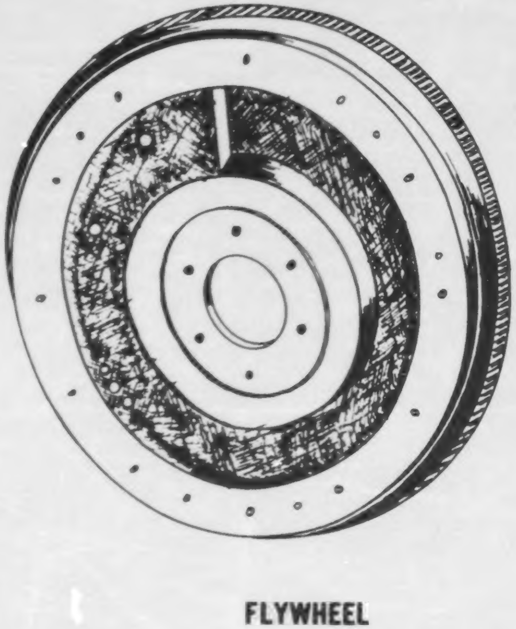


POWER

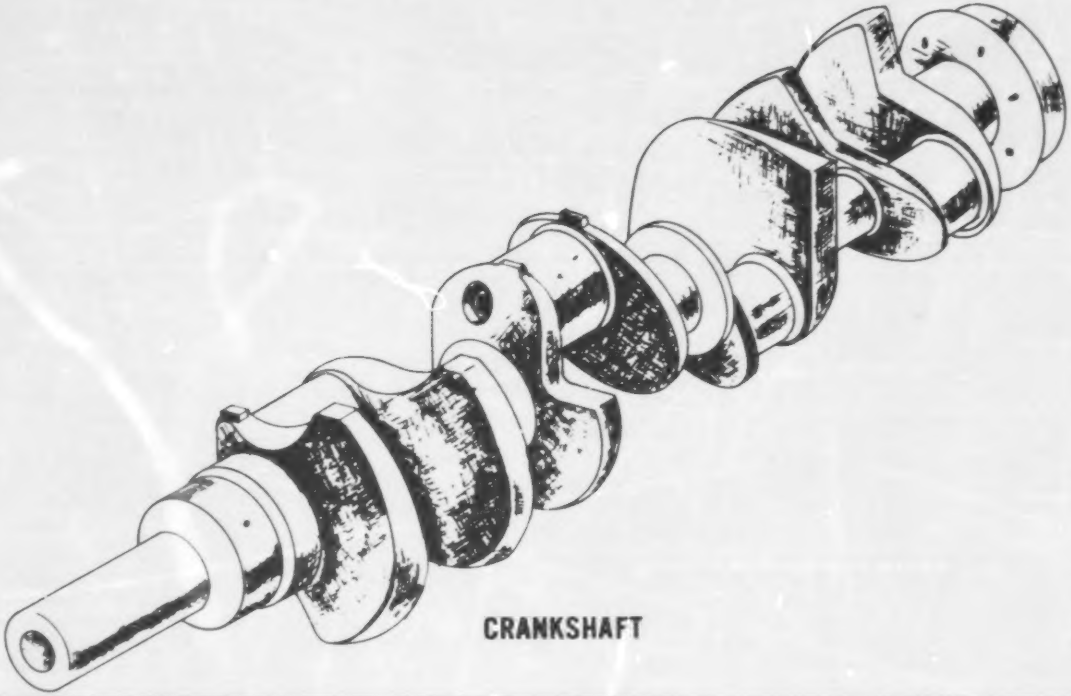


EXHAUST

CRANKSHAFT AND FLYWHEEL

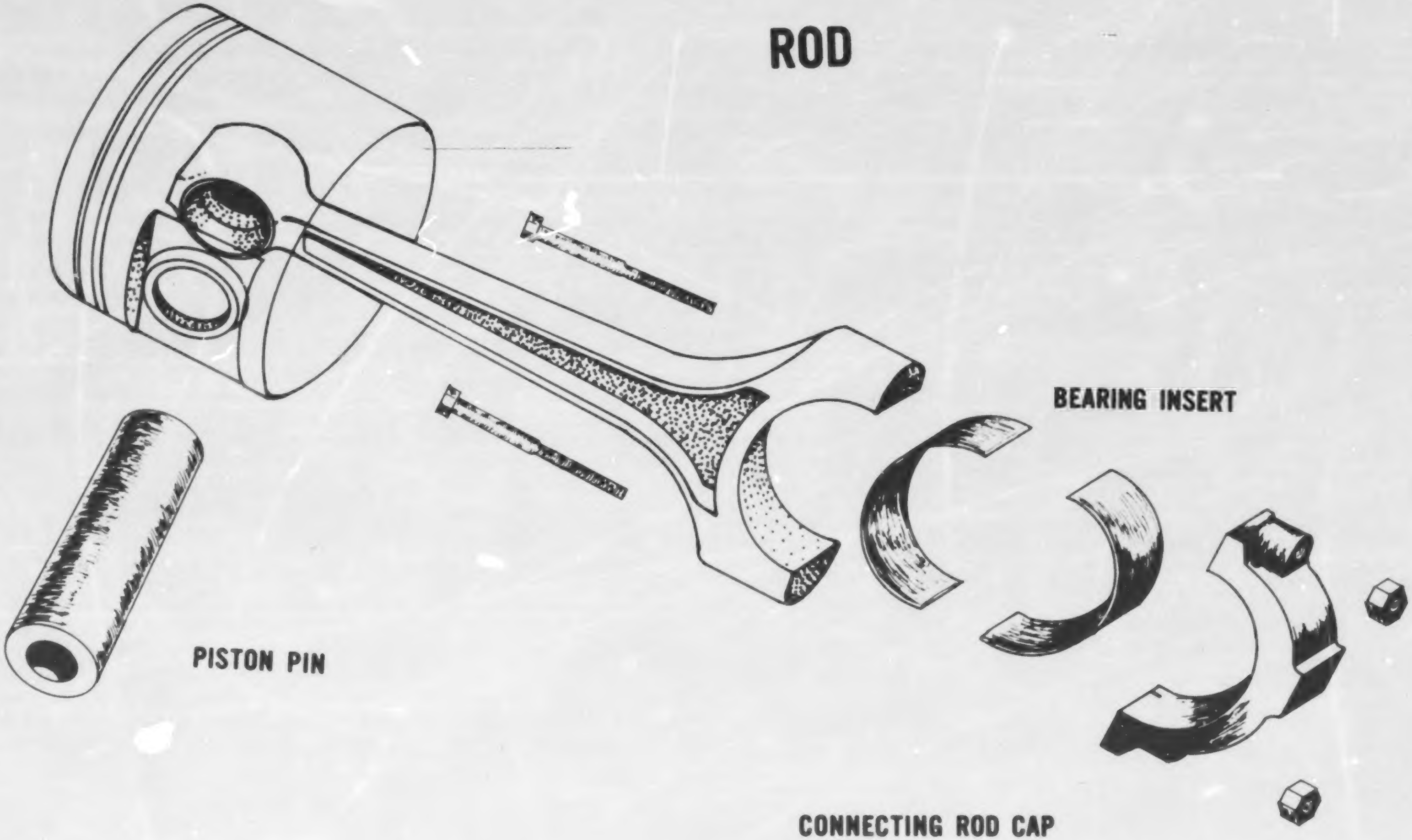


FLYWHEEL

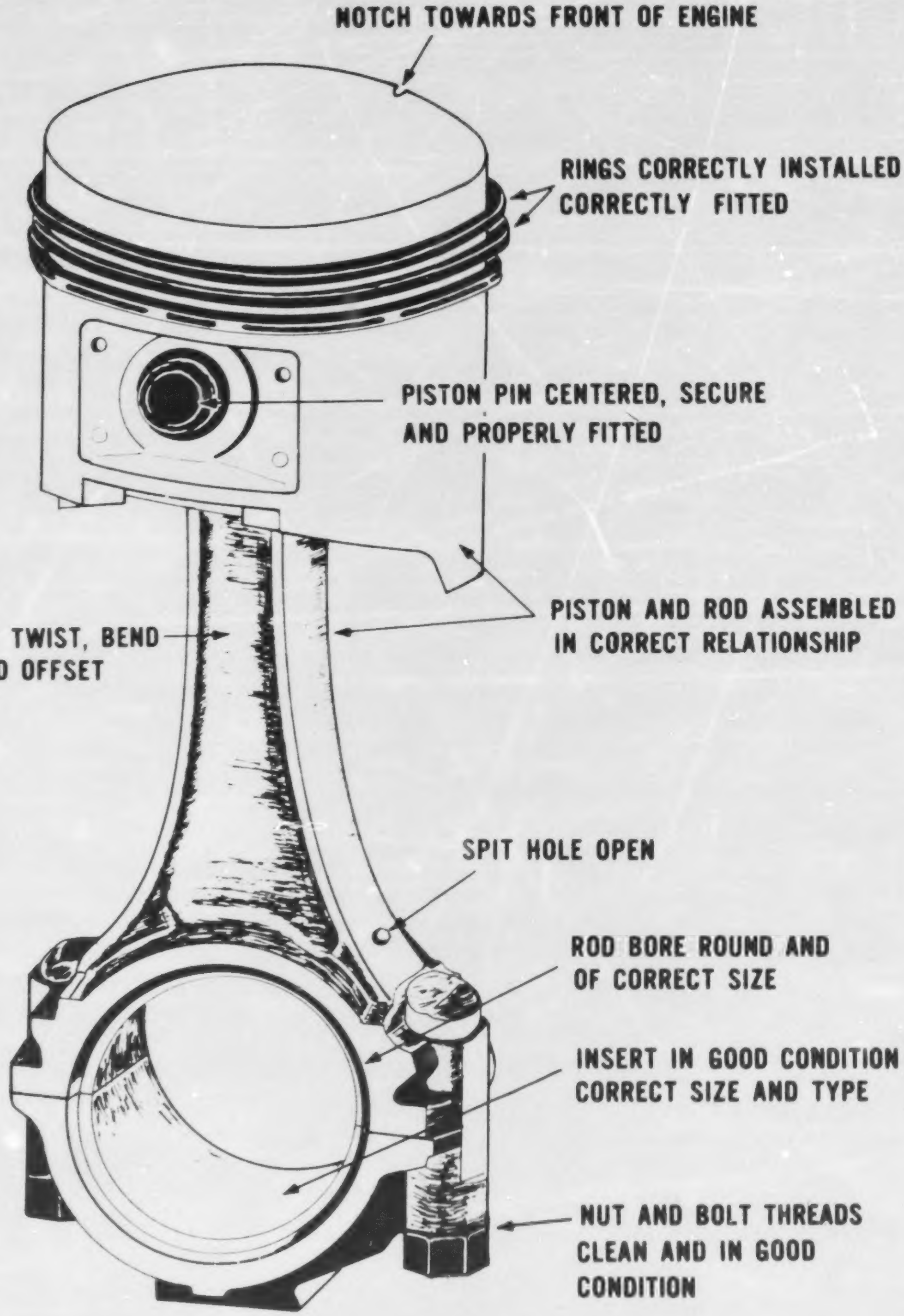


CRANKSHAFT

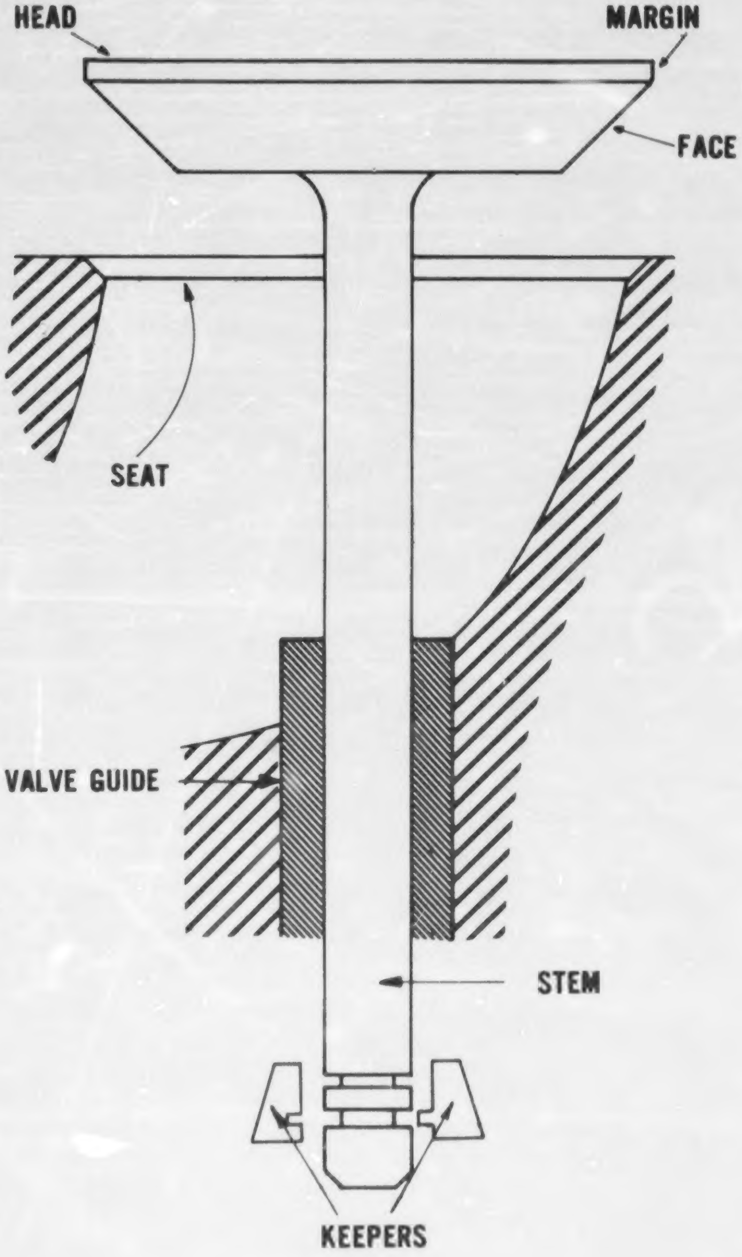
ROD


BEARING INSERT
PISTON PIN
CONNECTING ROD CAP

PISTON AND RINGS

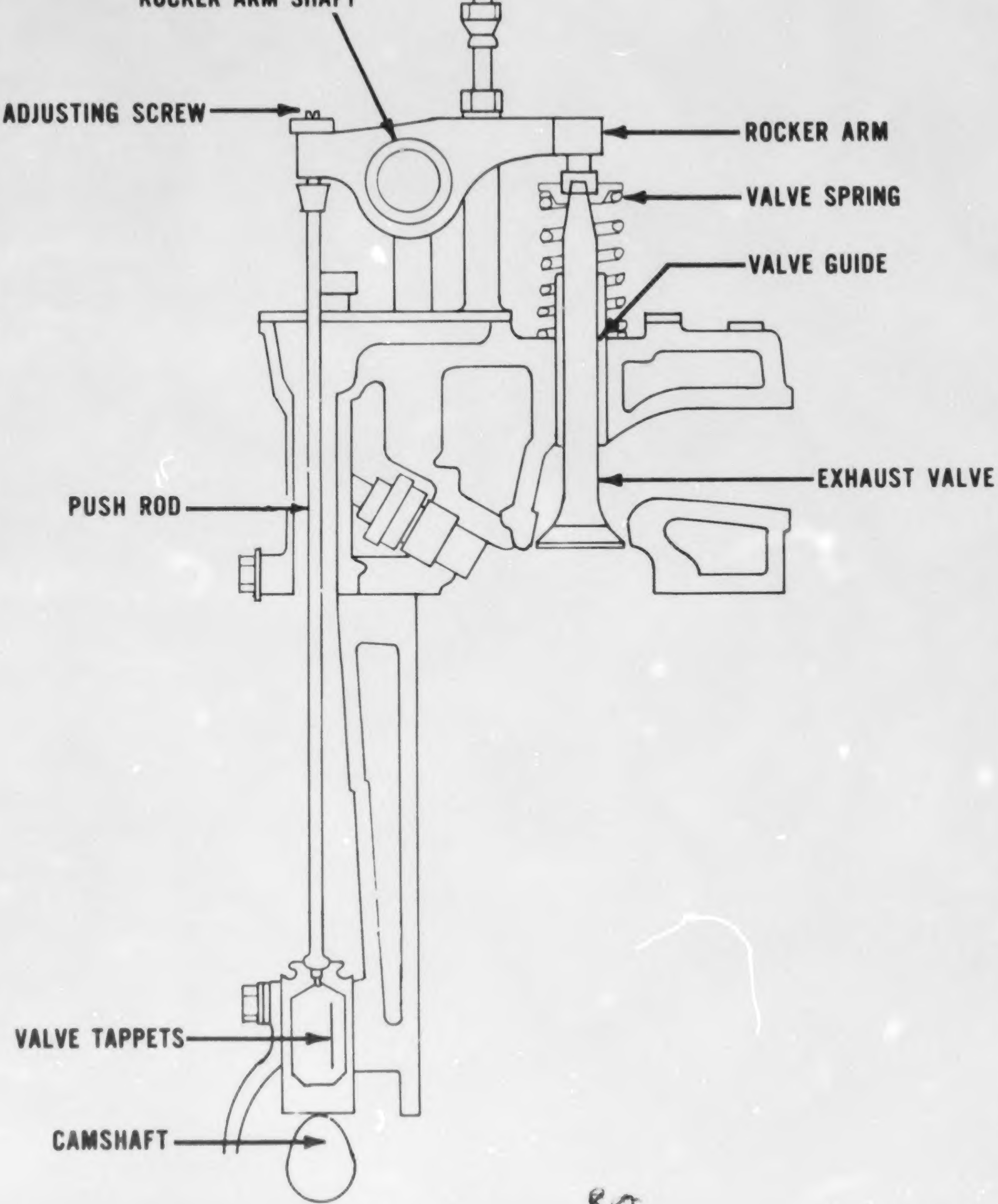

NOTCH TOWARDS FRONT OF ENGINE
RINGS CORRECTLY INSTALLED CORRECTLY FITTED
PISTON PIN CENTERED, SECURE AND PROPERLY FITTED
ROD FREE OF TWIST, BEND OR UNWANTED OFFSET
PISTON AND ROD ASSEMBLED IN CORRECT RELATIONSHIP
SPIT HOLE OPEN
ROD BORE ROUND AND OF CORRECT SIZE
INSERT IN GOOD CONDITION CORRECT SIZE AND TYPE
NUT AND BOLT THREADS CLEAN AND IN GOOD CONDITION

VALVE


HEAD
MARGIN
FACE
SEAT
VALVE GUIDE
STEM
KEEPERS

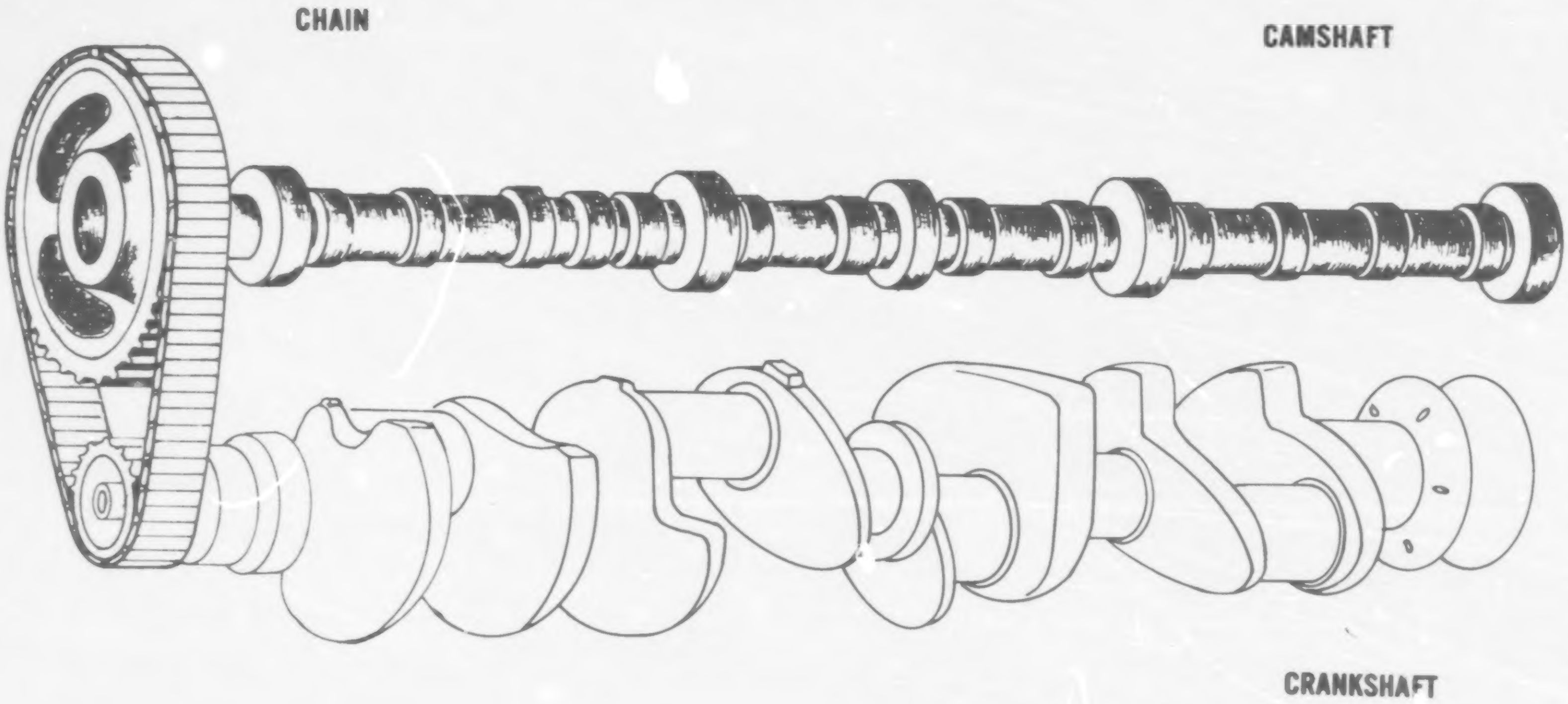
79

VALVE TRAIN

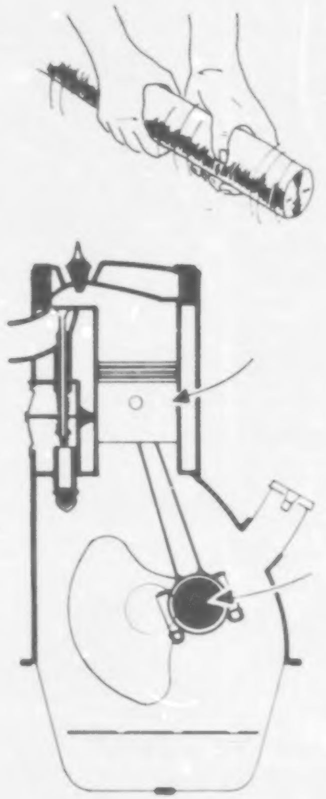

ROCKER ARM SHAFT
ADJUSTING SCREW
ROCKER ARM
VALVE SPRING
VALVE GUIDE
EXHAUST VALVE
PUSH ROD
VALVE TAPPETS
CAMSHAFT

80

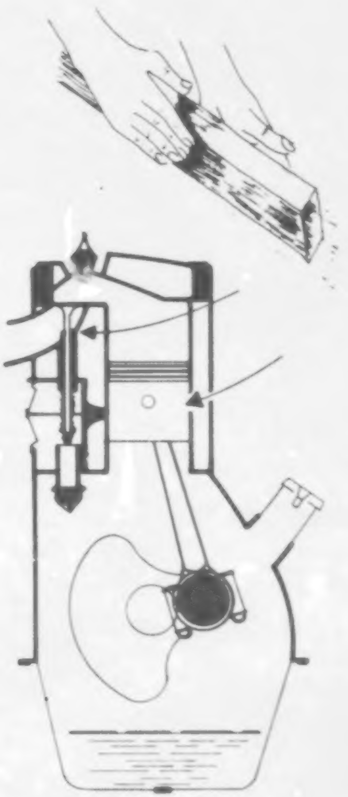
CAMSHAFT


CHAIN
CAMSHAFT
CRANKSHAFT

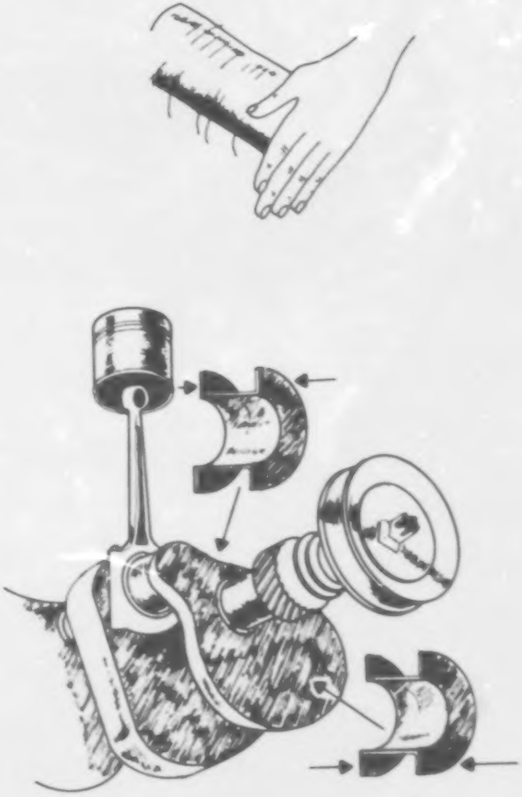
BEARING TYPES



JOURNAL



GUIDE



THRUST

TM-10

UNIT III

ENGINE PRINCIPLES

TEST--SECTION 1

1. Explain the purpose of the combustion engine.

2. Point out the differences in the internal and external-combustion engines.

   a. Internal combustion

   b. External combustion

3. Match the term with the proper explanation of each of the terms associated with the combustion engine.

____a. The lower part of the piston

____b. The part of the piston through which the piston pin is inserted

____c. The part of the valve that comes into contact with the valve seat

____d. The housing within which the crankshaft and many other engine parts operate and are oiled

____e. Area on the engine with which the valve head comes in contact

____f. Pieces of metal used to secure the valve spring onto the valve

____g. Connects a rod to the piston

____h. Device used to open or close an opening

____i. A replaceable load-carrying part

____j. The shaft containing lobes or cams

1. Piston boss
2. Valve face
3. Piston skirt
4. Crankcase
5. Keepers
6. Piston pin
7. Valve seat
8. Camshaft

____k. The journal for a bearing in the small end of a connecting rod

____l. A flexible piece of metal used to seal the piston with the cylinder walls during the power and compression strokes

____m. A round part closed on one end

____n. Main framework of the piston engine

____o. A shaft connecting the piston to the crankshaft

____p. The main shaft running through the engine

____q. Cuts down on friction

____r. Provides space to mount external parts

____s. Installed in a cylinder hole

____t. Allows fuel to come into the engine

____u. Used to open the engine valves

____v. Transfers the force of the explosion from the piston to the crankshaft

____w. Converts the up and down motion of the piston to usable rotary power

____x. Houses all internal parts

____y. Transfers force of explosion to a connecting rod

9. Piston
10. Block
11. Connecting rod
12. Bearing
13. Ring
14. Camshaft
15. Valves
16. Crankshaft
17. Piston pin
18. Crankcase

UNIT III

ENGINE PRINCIPLES

TEST--SECTION 2

4. Identify the three elements necessary to cause an explosion in the cylinder by placing a "✓" mark beside the correct answers below.

____a. water

____b. fire

____c. wind

____d. air

____e. fuel

5. Arrange the functions for starting an engine in the proper order by numbering 1 through 4 for each of the following.

____a. The correct amount of fuel and air mixture

____b. The spark must fire near the top of the compression stroke, which explodes the gas and pushes the piston downward.

____c. The fuel and air mixture introduced into the cylinder through the intake valve

____d. A method for cranking the engine to start it turning

6. Match each of the strokes to the function of the four-stroke cycles of a gasoline engine by placing the correct number to the left of each answer.

____a. As the piston moves downward, the intake valves open to allow the cylinder to be filled with the correct fuel-air mixture

____b. As the piston moves upward, both valves close, causing the fuel and air mixture to be compressed into a small area

1. Compression
2. Intake
3. Exhaust
4. Ignition
5. Power

____c. This action is not considered a stroke, but an event that occurs, causing the fuel-air mixture to explode.

____d. The piston begins a downward motion, being forced by expanding burning gases.

____e. The piston moves upward as the exhaust valve opens, allowing the burned gases to be forced from the cylinder.

7. Point out the function of each of the parts of the valve train by placing the appropriate number to the left of each letter.

____a. Camshaft

____b. Lifter

____c. Pushrod

____d. Rocker arm

1. Pushes the valve open
2. Pushes the rocker arm
3. Raises the pushrods
4. The lobes lift the hydraulic lifters.

8. Determine the function of each type of ring used on the piston by placing the correct number to the left of each letter.

____a. Compression ring

____b. Wiper ring

____c. Oil ring

1. Seals the piston within the cylinder and prevents explosion "blow by"
2. Wipes the oil off the cylinder wall back into the oil pan on the downward movement of the piston
3. Applies oil to the cylinder wall on the upward stroke of the piston

9. Arrange the events of a power sequence in order, beginning with explosion over piston.

____a. Explosion over piston

____b.

1. Pushrod drives the rocker arm
2. Piston drives rod

c.

d.

e.

f.

g.

h.

3. Rocker arm opens valve

4. Camshaft drives the lifter

5. Rod drives the crankshaft

6. Lifter raises the pushrod

7. Crankshaft drives the camshaft

10. Determine the functions of a flywheel by answering "yes" or "no" to each of the following statements.

____a. The flywheel acts as a balance to smooth the engine.

____b. The flywheel provides a gear to turn the water pump.

____c. The flywheel provides a starter gear.

____d. The flywheel acts as a centrifugal wheel to carry the engine to the next stroke.

____e. The flywheel changes the direction of rotation to the transmission.

UNIT III

ENGINE PRINCIPLES

ANSWERS TO TEST--SECTION 1

1. The purpose of the combustion engine is to convert raw materials such as gasoline into mechanical power to do the many work-related jobs needed by man.

2. a. A device used to burn raw materials within itself

   b. A device used to accept the pressure of raw materials being burned in another source and then introduced into the engine

3. a. 3

   b. 1

   c. 2

   d. 4

   e. 7

   f. 5

   g. 6

   h. 8

   i. 12

   j. 17

   k. 17

   l. 13

   m. 9

   n. 10

   o. 11

   p. 16

   q. 12

   r. 10

s. 9
t. 15
u. 14
v. 11
w. 16
x. 18
y. 9

SECTION 2

4. a. 4
b. 3
c. 2
d. 1
5. a. 1
b. 2
c. 3
6. a. yes
b. no
c. yes
d. yes
e. no
7. a.
b. ✓
c.
d. ✓
e. ✓

8. a. 2

b. 4

c. 3

d. 1

9. a. 2

b. 1

c. 4

d. 5

e. 3

10. a. Explosion over piston

b. Piston drives rod

c. Rod drives crankshaft

d. Crankshaft drives camshaft

e. Camshaft drives the lifter

f. Lifter raises the pushrod

g. Pushrod drives the rocker arm

h. Rocker arm opens the valve

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

UNIT OBJECTIVE

After completion of this unit, the student will be able to discuss the operation of the fuel system and repair each of its components. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the automotive fuel system.
2. Match the terms and definitions associated with the fuel system.
3. Describe the construction of the fuel tank.
4. Select the proper uses of fuel lines
5. Point out the operation of the fuel pump.
6. Locate the different fuel filters and explain the purpose of these filters.
7. Explain the operation of the carburetor.
8. Demonstrate the ability to:
    a. Remove the fuel tank.
    b. Check out a fuel tank indicating system.
    c. Replace liquidometer.
    d. Check fuel system for leakage and security.
    e. Remove and replace fuel pump.
    f. Clean fuel filter.
    g. Check and replace needle valve in carburetor.
    h. Adjust carburetor idel speed.
    i. Adjust carburetor fuel-air idle mixture.
    j. Remove and/or replace air filters.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide students with objective sheet

   B. Discuss unit and specific objectives

   C. Make transparencies

   D. Provide students with information and job sheets

   E. Discuss information and job sheets

   F. Show and discuss transparencies

II. Student

   A. Read objective sheet

   B. Study information sheet

   C. Perform the jobs as described on the job sheets

   D. Take test

INSTRUCTIONAL MATERIALS

I. Included in this unit

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM-1--Automobile Fuel System

      2. TM-2--Construction of a Typical Gasoline Tank

      3. TM-3--Typical Serviceable Fuel Pump

      4. TM-4--Nonserviceable Fuel Pump

      5. TM-5--Fuel Filters

6. TM-6--Basic Carburetor
7. TM-7--Air Filters

D. Job sheets

1. Job Sheet #1--Remove Fuel Tank
2. Job Sheet #2--Repair Fuel Tank Indicating System
3. Job Sheet #3--Check Fuel System for Leaks
4. Job Sheet #4--Remove and Replace Fuel Pump
5. Job Sheet #5--Clean or Replace Fuel Filter
6. Job Sheet #6--Check and Replace Needle Valve in Carburetor
7. Job Sheet #7--Adjust Carburetor Idle Speed
8. Job Sheet #8--Adjust Carburetor Fuel-Air Idle Mixture
9. Job Sheet #9--Remove and/or Replace Air Filter

E. Test

F. Answers to test

II. References:

A. Stockel, Martin W. Auto Mechanics Fundamentals. Chicago: Goodheart-Wilcox Company, Inc., 1974.

B. Wetzer, Guy F. Automotive Diagnosis and Tune Up. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1964.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

INFORMATION SHEET

I. The purpose of the automotive fuel system is to store, transfer, and mix fuel and air for feeding into the engine during operation.

II. Terms

- A. Baffles--Metal plates separating the fuel tank into sections, yet allowing fuel to pass slowly between them
- B. Liquidometer--Device used to measure quantity of fuel in the fuel tank
- C. Diaphragm--A device made of thin layers of cloth bound together with a special compound that makes it airtight and resistant to petroleum products
- D. Accelerate--To go from a low speed to a high speed

III. Fuel tank

- A. A metal container for the storage of fuel
- B. Contains baffles to keep the fuel from shifting or sloshing
- C. Contains a vent so that the fuel may be drawn out
- D. Has a filler opening to allow fuel to enter the tank
- E. Houses a liquidometer that gives an accurate description of the amount of gas left in the tank

IV. Fuel lines

- A. Used to transmit fuel to the engine
- B. Constructed of steel, approximately 5/16" in diameter

V. Fuel pump

- A. Receives fuel from the tank and sends it under pressure to the carburetor

  - B. A diaphragm-type pump
  - C. Driven by the camshaft

VI. Fuel filters

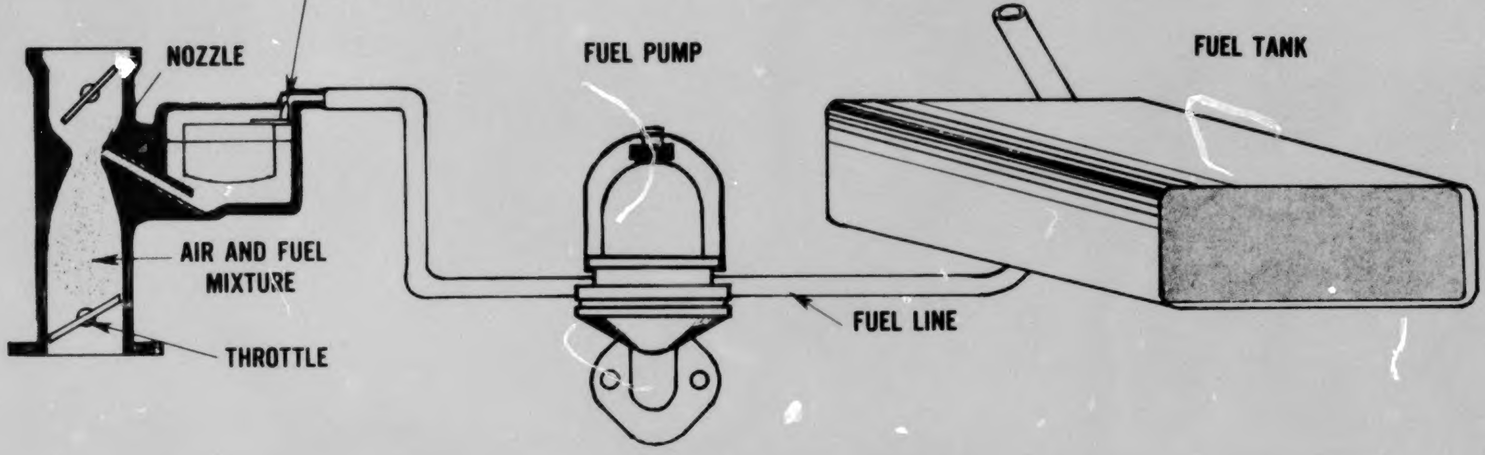
  - A. Types
    - 1. Ceramic
    - 2. Disposable
    - 3. In-line
    - 4. Bowl type
  - B. Function--To remove dirt and water from the fuel
  - C. Location
    - 1. In the tank at the fuel suction pick-up
    - 2. At the fuel pump inlet
    - 3. Between the pump and carburetor

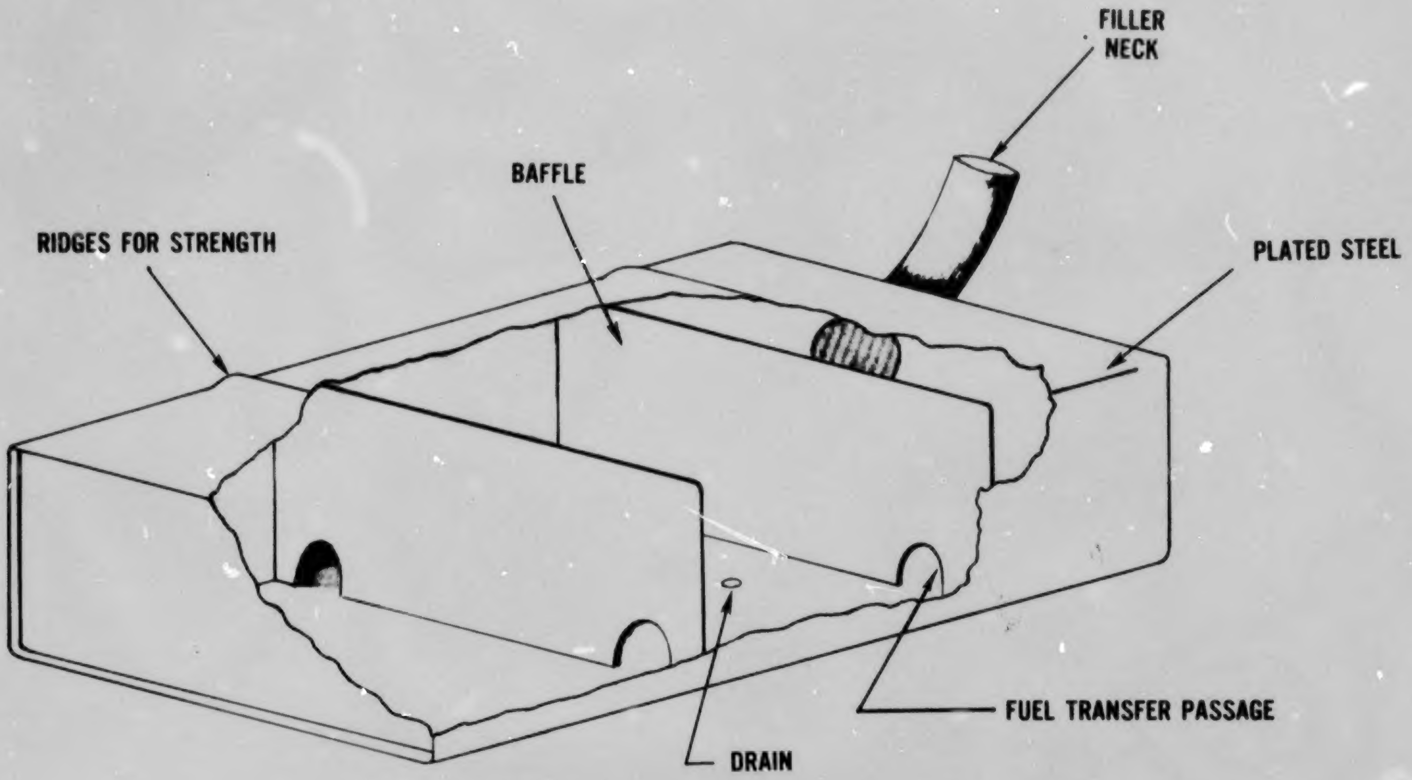
VII. Carburetor

  - A. A device that mixes fuel and air for entry into the engine
  - B. Mixes fuel and air at a ratio of 13 parts air to 1 part fuel
  - C. Houses three fuel circuits or fuel routes
    - 1. Idle circuit
    - 2. High-speed circuit
    - 3. Acceleration circuit

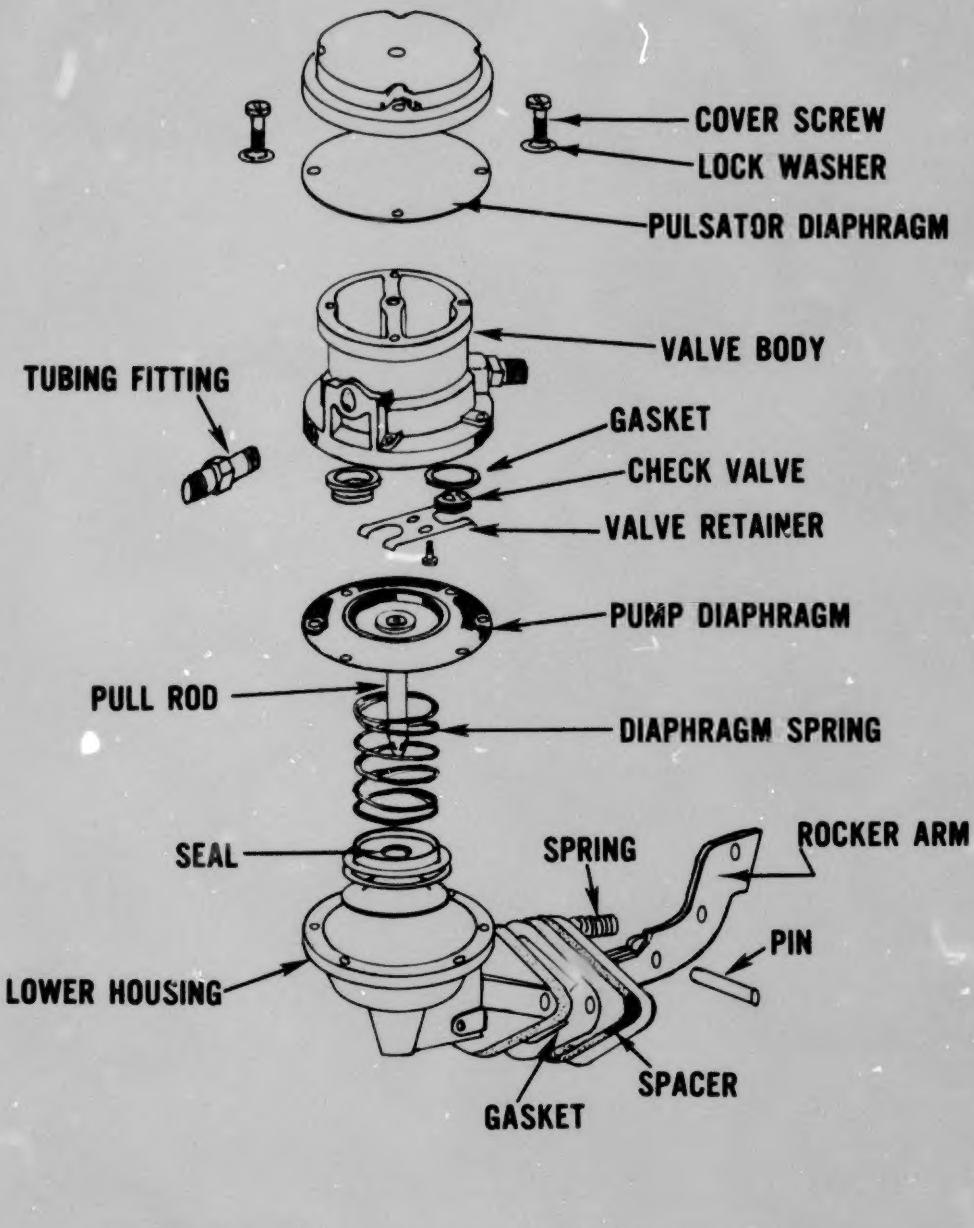
VIII. Air filter--a unit located on the top of the carburetor

AUTOMOBILE FUEL SYSTEM


FUEL INTAKE VALVE
NOZZLE
FUEL PUMP
FUEL TANK
AIR AND FUEL MIXTURE
THROTTLE
FUEL LINE

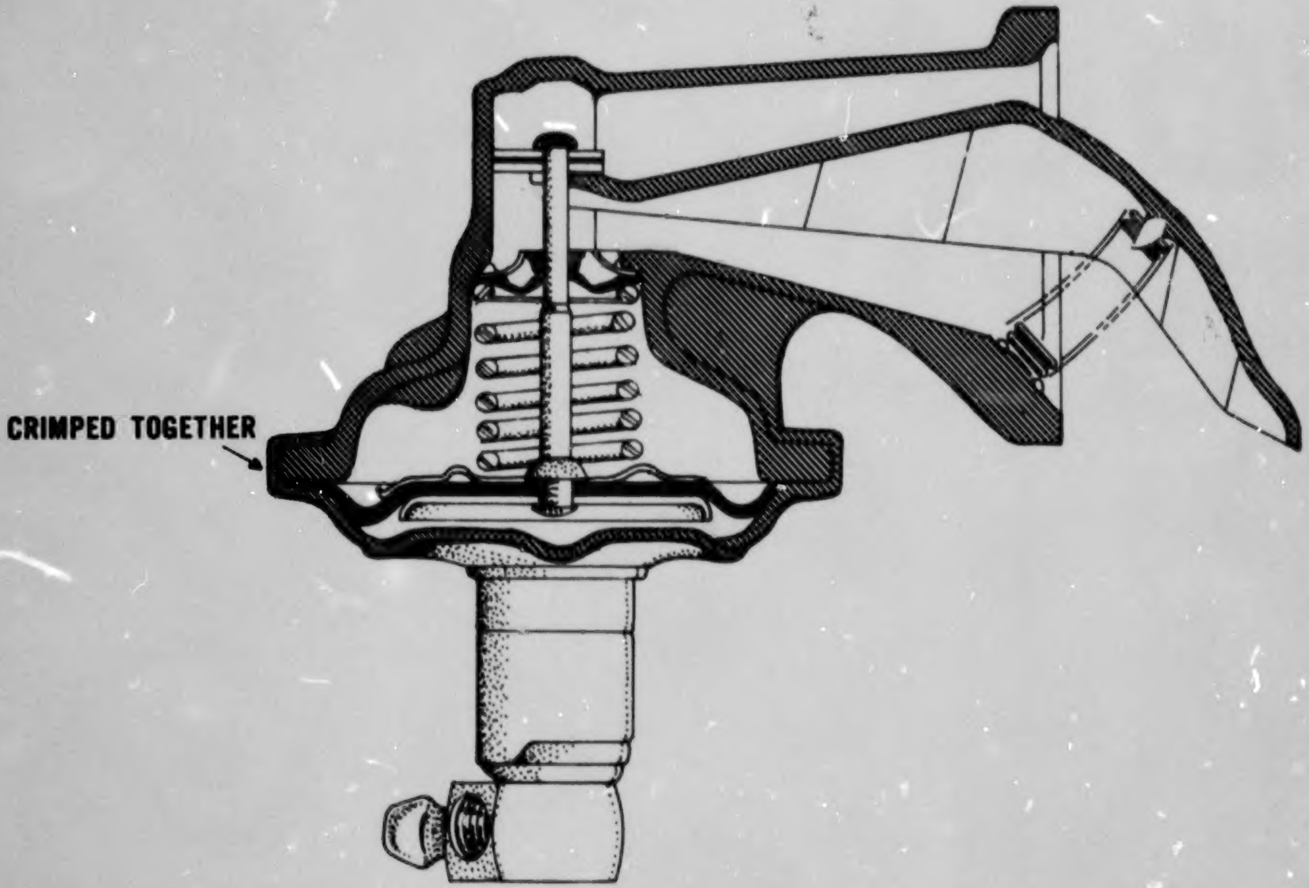

FILLER NECK
BAFFLE
RIDGES FOR STRENGTH
PLATED STEEL
FUEL TRANSFER PASSAGE
DRAIN

CONSTRUCTION OF A TYPICAL GASOLINE TANK

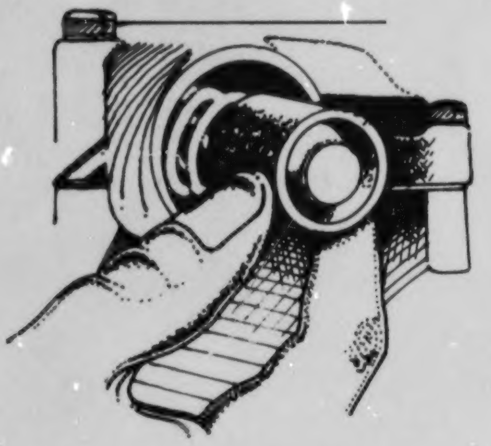

COVER SCREW
LOCK WASHER
PULSATOR DIAPHRAGM
VALVE BODY
TUBING FITTING
GASKET
CHECK VALVE
VALVE RETAINER
PUMP DIAPHRAGM
PULL ROD
DIAPHRAGM SPRING
SEAL
SPRING
ROCKER ARM
PIN
LOWER HOUSING
SPACER
GASKET

TYPICAL SERVICABLE FUEL PUMP

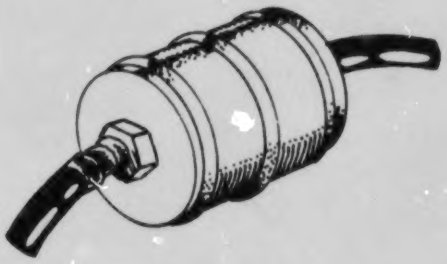
NONSERVICABLE FUEL PUMP


CRIMPED TOGETHER

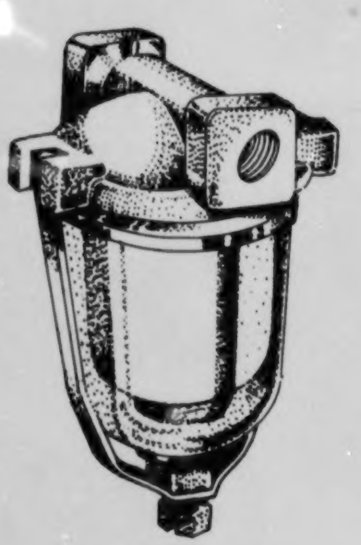
FUEL FILTERS



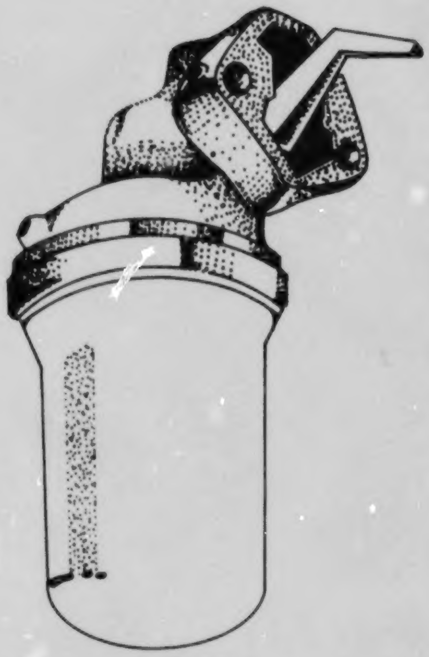
CERAMIC



IN-LINE

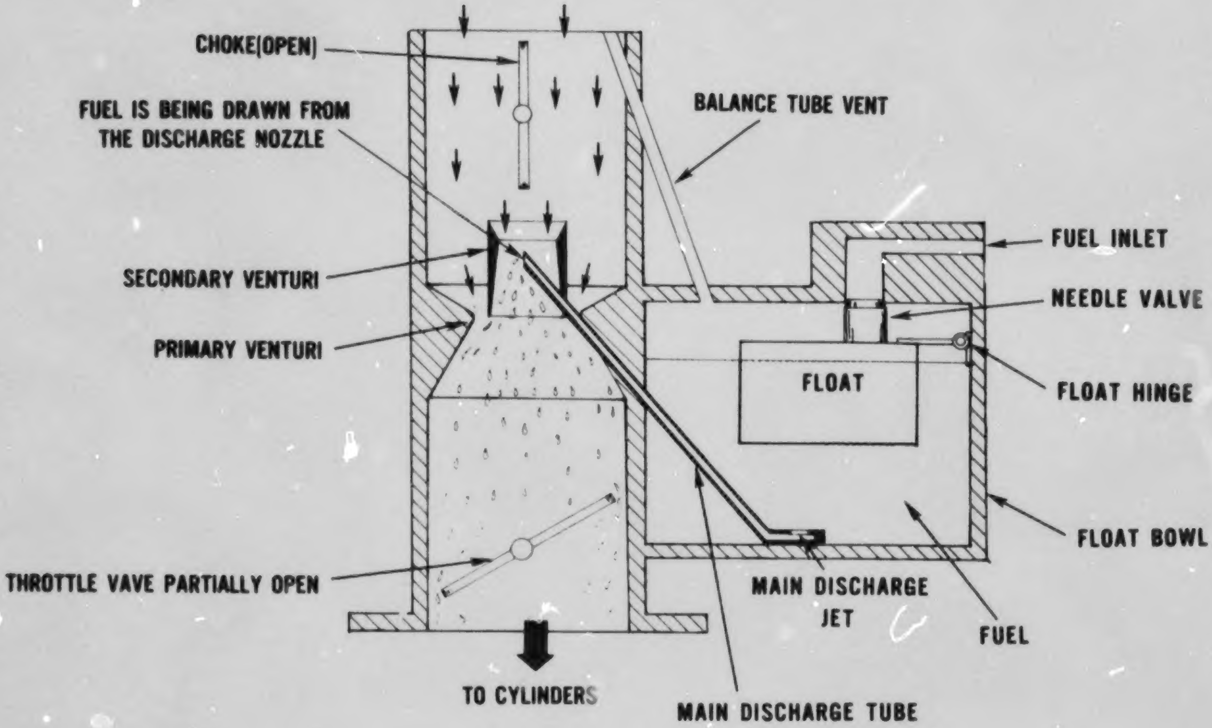


BOWL TYPE

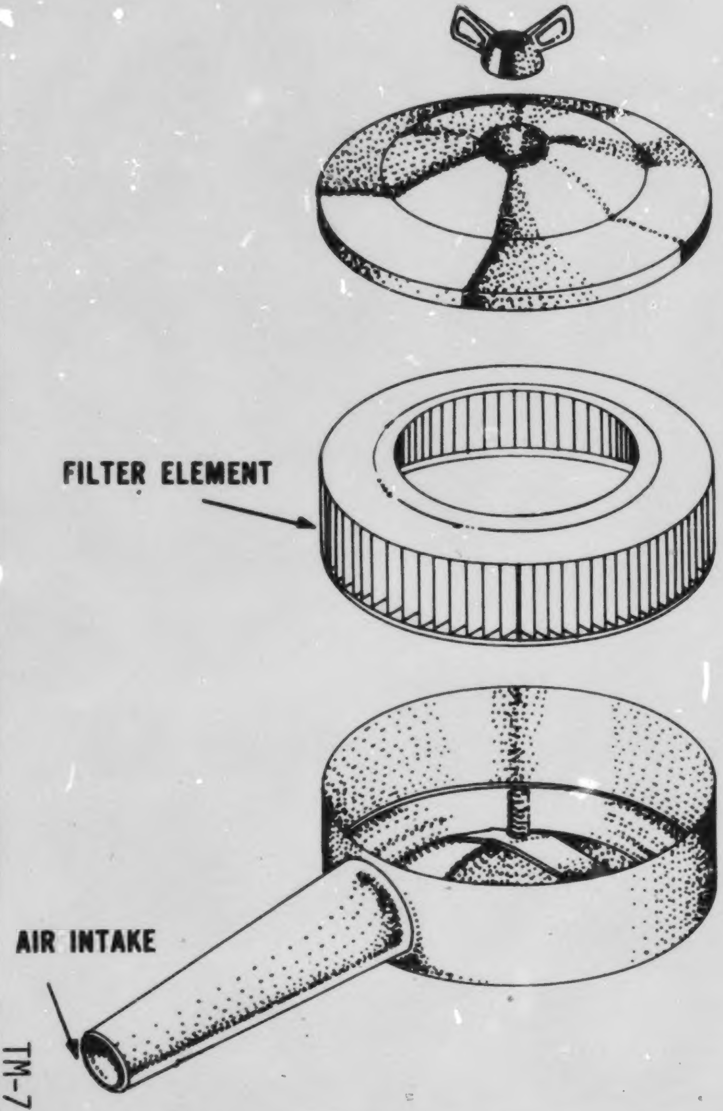


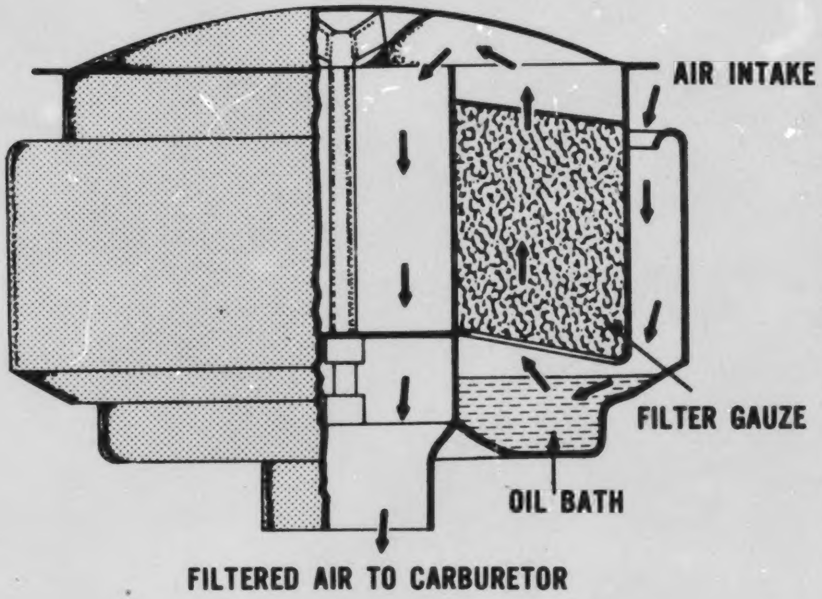
DISPOSABLE

BASIC CARBURETOR


CHOKE(OPEN)
FUEL IS BEING DRAWN FROM THE DISCHARGE NOZZLE
SECONDARY VENTURI
PRIMARY VENTURI
THROTTLE VAVE PARTIALLY OPEN
TO CYLINDERS
BALANCE TUBE VENT
FUEL INLET
NEEDLE VALVE
FLOAT
FLOAT HINGE
FLOAT BOWL
MAIN DISCHARGE JET
FUEL
MAIN DISCHARGE TUBE

AIR FILTERS


FILTER ELEMENT
AIR INTAKE


AIR INTAKE
FILTER GAUZE
OIL BATH
FILTERED AIR TO CARBURETOR

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #1--REMOVE FUEL TANK

I. Tools required

  A. 3/8" drive socket set

  B. Hose clamp pliers

  C. Common screwdriver

  D. Phillips screwdriver

II. Procedure

  SAFETY WARNING: The draining of fuel and removal of tank should be done outside of shop to avoid fires

  A. Check tank for fuel capacity

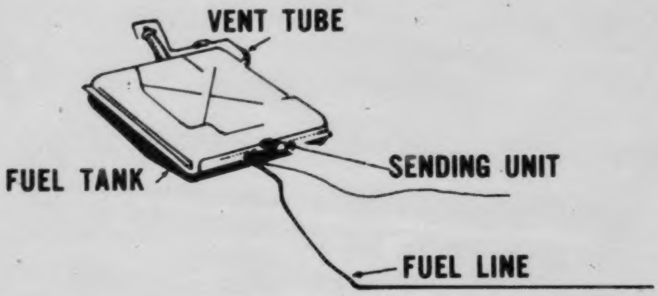
  B. Remove gas tank cap

  C. Drain (or siphon) fuel from tank at bottom of drain plug

  (NOTE: Make sure container will hold fuel drained.)

  D. Disconnect fuel feed line with hose clamp pliers

  E. Disconnect vent line with hose clamp pliers



  F. Disconnect electric wires at tank-sending unit using a common screwdriver

  G. Remove screws around filler neck and remove fairing

H. Examine the sending unit for problems.

I. Check float to see if it will float.

J. Remove wire from sending unit and touch it to the frame of car.

(NOTE: Gauge should read FULL.)

K. Remove and replace sending unit if necessary.

L. Install drain plug in gas tank if removed.

M. Insert tank sending-unit in tank with float in down position.

N. Secure the ring and screws.

O. Connect the vacuum line and secure the hose clamp.

P. Connect the fuel feed line with hose clamp pliers.

Q. Connect the electrical wire with a screwdriver or nut driver.

R. Fill the tank with gasoline and check for leaks.

S. Check the gauge in the car to see if it shows the right amount.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #2--REPAIR FUEL TANK INDICATING SYSTEM

I. Tools required

A. Drain pan

B. Crescent wrench

C. Common screwdriver

D. Phillips screwdriver

E. Hose clamp pliers

F. Nut driver

II. Procedure

SAFETY WARNING: This job must be performed outside shop.

A. Drain tank to amount below the level of tank indicating unit from drain plug at tank bottom or by siphoning.

B. Remove wire, vent, and feed line from tank-sending unit, using common screwdriver and hose clamp pliers.

C. Turn indicating unit counterclockwise and lift away from tank.

D. With tank unit out, reconnect electrical wire and ground unit to auto frame.

E. Turn the auto ignition key to the ON position.

F. Move float arm on sending unit slowly down and up.

G. Have someone look at fuel quantity gauge.

(NOTE: Needle on gauge should vary from full to empty as float is being moved. If the needle moves off the scale on the full side, the wire to sending unit is grounded. If the needle moves off the scale on the empty side, the gauge is not working.)

H. Loosen bolts holding tank straps and remove

I. Lower tank carefully to avoid denting

(NOTE: These are basic procedures for removing lower, rear-mounted gas tanks only. For removing gas tanks from Volkswagen, station wagon, Mustang, and others, refer to specific manufacturers' technical manuals.)

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #3--CHECK FUEL SYSTEM FOR LEAKS

I. Tools required

None

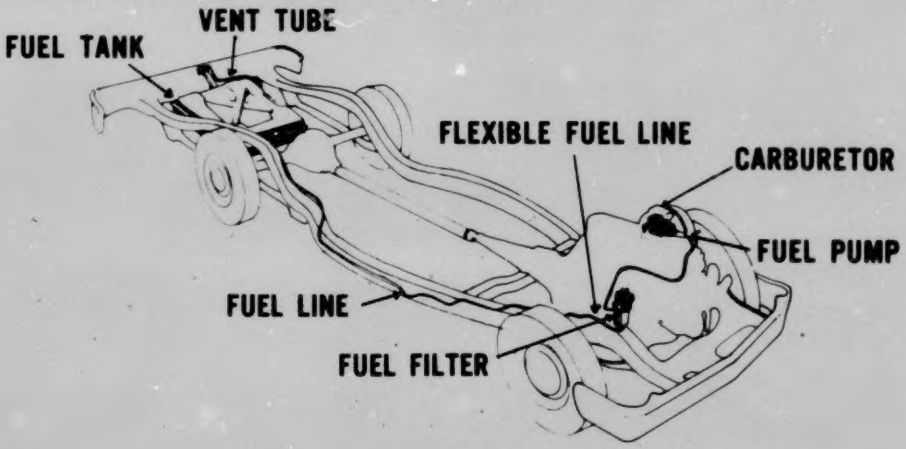
II. Procedure

A. Be sure gas tank is full.

B. Check tank for leaks at filler neck, drain plug, vents, and fuel line.

C. Tighten clamps if leaks are found

D. Check the fuel line along frame toward engine for rubbing, and check metal clamps for security.


VENT TUBE
FUEL TANK
FLEXIBLE FUEL LINE
CARBURETOR
FUEL PUMP
FUEL LINE
FUEL FILTER

E. Adjust the line to stop any rubbing and replace any broken clamps.

F. Inspect rubber hose from the metal fuel line to fuel pump inlet.

G. Tighten any leaking clamps and replace the hose if it is cracked.

H. Put car in neutral and secure emergency brake.

I. Start engine.

J. Check the fuel filter and pump for leaks.

K. Tighten any leaking parts

L. With engine running, check lines from pump to carburetor for leaks.

M. Tighten fittings carefully if there are leaks.

N. When you are satisfied that there are no leaks, turn engine off.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #4--REMOVE AND REPLACE FUEL PUMP

I. Tools required

A. 1/2" x 9/16" open end wrench

B. 5/8" socket set

C. Hose clamp pliers

II. Procedure

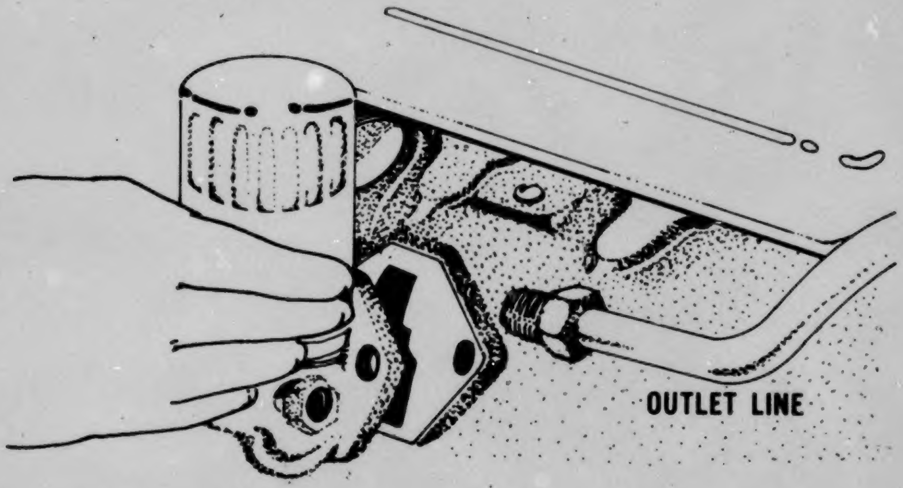
A. Removal

1. Using an open end wrench, disconnect outlet line from fuel pump to carburetor.

2. Disconnect inlet hose from tank with hose clamp pliers.

(NOTE: If gasoline drains from tank, put a bolt in line to stop flow.)

3. Using the socket set, remove mounting bolts from engine block.



4. Lift fuel pump out from block.

B. Replacement

1. Install new fuel pump gasket.

2. Mount fuel pump to block.

   (CAUTION: Make sure stroke arm is above camshaft.)

3. Firmly tighten the two mounting bolts.

4. Remove bolt from tank line and replace to pump using hose clamp pliers.

5. Install pressure gauge to outlet side of fuel pump and crank engine.

   (NOTE: The gauge should read from 5 to 7 pounds of pressure.)

6. Disconnect gauge if reading is satisfactory, and reconnect outlet line to fuel pump.

7. Put car in neutral and secure emergency brake.

8. Start engine.

   (NOTE: If engine continues to run, fuel pump is good.)

9. If engine fails to continue to run, recheck system.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #5--CLEAN OR REPLACE FUEL FILTER (BOWL AND CERAMIC INSERT TYPES)

I. Tools required

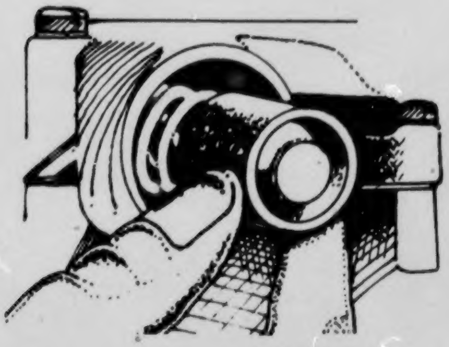
- A. Hose clamp pliers
- B. Adjustable wrench or open end box end wrenches
- C. Air hose

II. Procedure

(CAUTION: Procedure should be done outside shop.)

A. Ceramic filter

1. Remove the ceramic filter at the carburetor



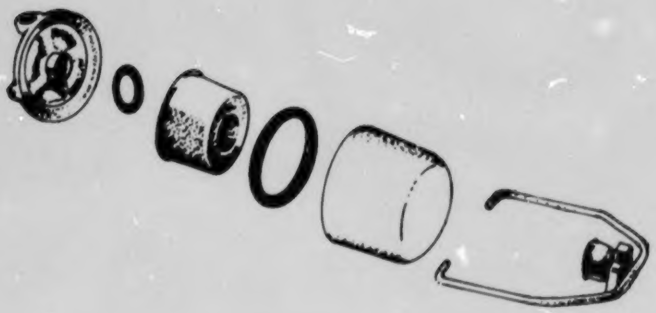
2. Using air hose, apply air on outlet side of filter blowing all trash out the inlet side.

   (NOTE: If filter cannot be cleaned, it should be replaced.)

3. Replace filter with the small inner cone away from the carburetor.

B. Bowl type filter

1. Release hold-down screw of wire bail on fuel filter glass bowl.



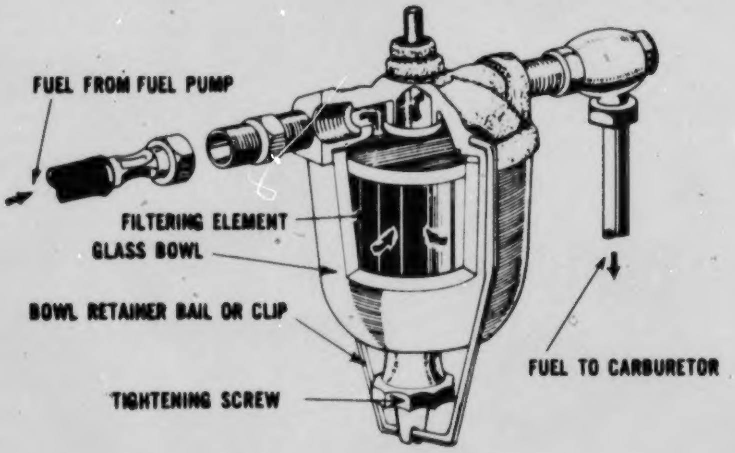
2. Remove trash from bowl

3. Check bowl gasket for condition and replace if necessary.

4. Clean screen at top of bowl.

5. Install bowl and tighten hold-down thumb nut on bail.

6. Operate system and check for leaks.


FUEL FROM FUEL PUMP
FILTERING ELEMENT
GLASS BOWL
BOWL RETAINER BAIL OR CLIP
TIGHTENING SCREW
FUEL TO CARBURETOR

C. In-line and disposable filters

(NOTE: These filters should be replaced only.)

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

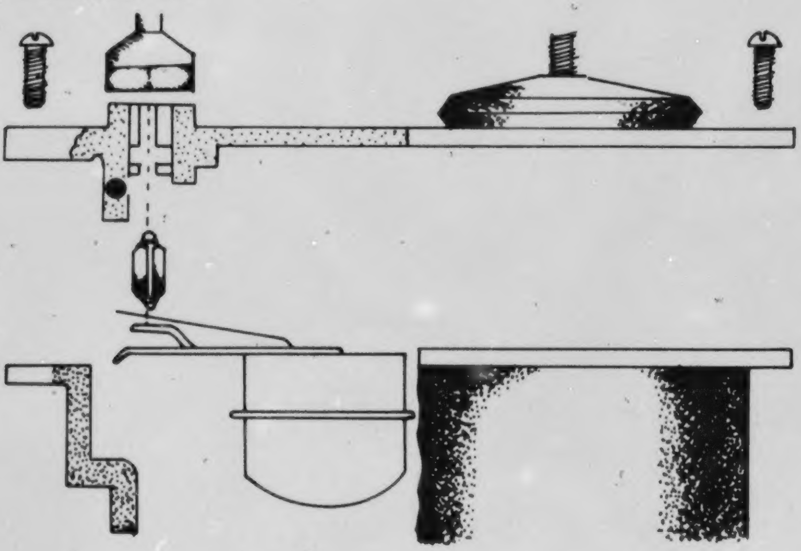
JOB SHEET #6--CHECK AND REPLACE NEEDLE VALVE IN CARBURETOR

I. Tools required

- A. 8" crescent wrench
- B. 1/2" x 9/16" open end wrench
- C Phillips screwdriver
- D. Common screwdriver

II. Procedure

- A. Remove air filter by loosening wing nut.
- B. Disconnect any controls to top of carburetor, using screwdriver.
- C. Remove air filter hold-down bolt with 1/2" x 9/16" open end wrench.
- D. Disconnect inlet line from fuel pump using crescent and open end wrench.
- E. Using a screwdriver, remove all screws from top of carburetor.



F. Lift top off carburetor.

G. Remove float and needle valve.

H. Remove all dirt particles from valve seats and bowl.

I. Check condition of needle valve and replace if necessary.

J. Replace the float.

K. Replace the carburetor top and tighten the screws with a common screwdriver.

L. Replace air filter hold-down bolt, using a 1/2" x 9/16" wrench.

M. Connect fuel inlet line from carburetor with a crescent and open end wrenches.

N. Replace all connections that were removed from the top of the carburetor.

O. Replace air filter, using wing nut.

P. Crank engine and look at carburetor for leaks.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #7--ADJUST CARBURETOR IDLE SPEED

I. Tools required

A. Common 2" screwdriver

B. Tachometer-dwell meter

II. Procedure

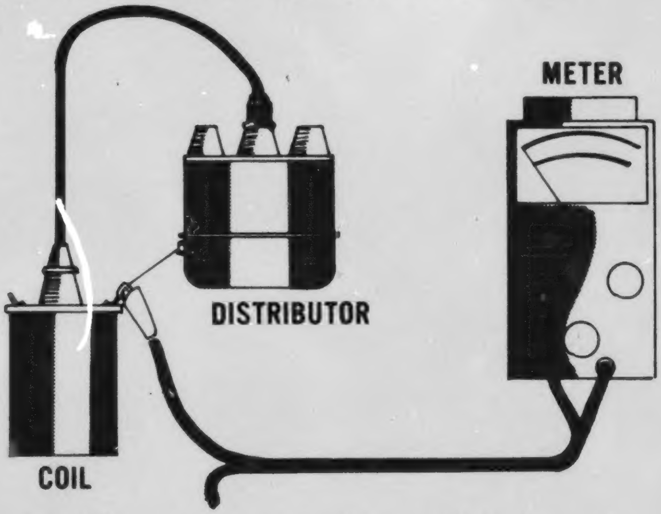
A. Put car in neutral and secure emergency brake.

B. Start engine and allow to warm up.

C. Remove air filter and make sure choke is in OFF position.

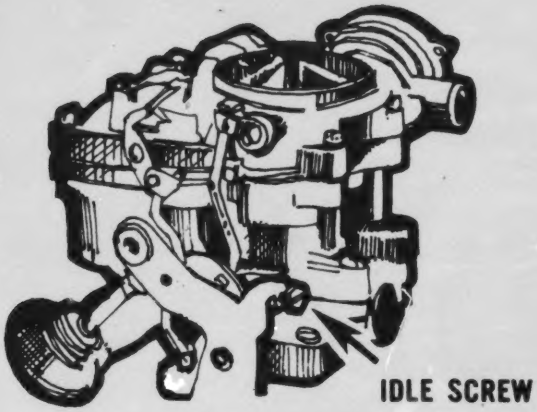
D. Tap accelerator pedal with your foot to disengage fast idle lever.

E. Install tachometer-dwell meter with the red lead to negative (minus) post on coil and a lead to ground (any metal surface on car).



F. Switch meter to tach position.

G. Locate throttle lever on carburetor and adjust with screwdriver to the correct idle speed as listed in manufacturer's guide or on decal in engine compartment.



H. Disconnect tachometer-dwell meter.

I. Turn off engine.

J. Close hood.

K. Collect tools and equipment and return to tool crib.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #8--ADJUST CARBURETOR FUEL-AIR IDLE MIXTURE

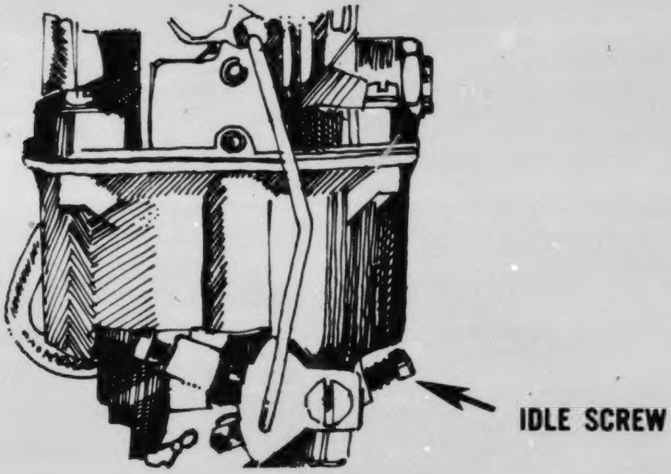
I. Tools required

Common 8" screwdriver

II. Procedure

A. One-Barrel Carburetor

1. Put car in neutral and secure emergency brake.
2. Start engine and allow it to warm up.
3. Pat the accelerator pedal with your foot and allow fast idle to go to OFF position.
4. Locate idle mixture screw at base of carburetor.

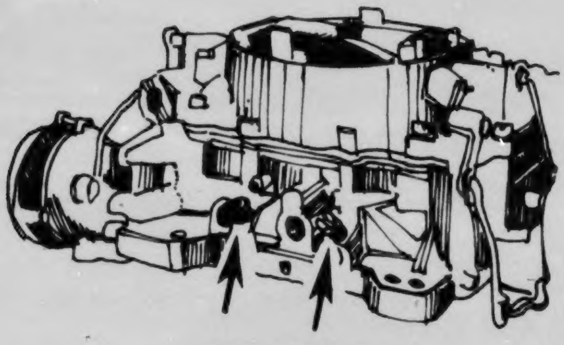


5. Turn idle adjustment screw clockwise until engine begins to miss.
6. Back screw out counterclockwise 1 1/2 turns or to the position in which the engine runs the smoothest.

B. Two-Barrel Carburetor

1. Put car in neutral and secure emergency brake.

2. Start engine and allow it to warm up.
3. Pat the accelerator pedal with your foot and allow the fast idle to go to the OFF position.
4. Locate the two idle screws at the base of the carburetor.



IDLE SCREWS

5. Facing the engine from the front and using a common screwdriver, turn the right side screw clockwise until engine beings to miss.
6. Back out screw counterclockwise 1 1/2 turns or to the position in which the engine runs the smoothest.
7. Repeat steps 4 and 5 for left idle screw.
8. Return tools to tool crib and close hood on car.

(NOTE: Each mixture screw adjusts the mixture for the bank of cylinders on which it is located.)

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

JOB SHEET #9--REMOVE AND/OR REPLACE AIR FILTER

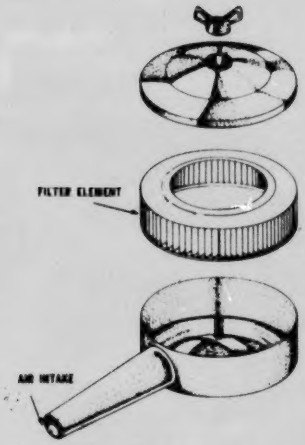
I. Tools required

None

II. Procedure

A. Dry or Paper Type Filter

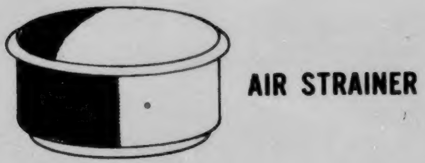
1. Remove wing nut at top of carburetor.
2. Lift off filter cover.

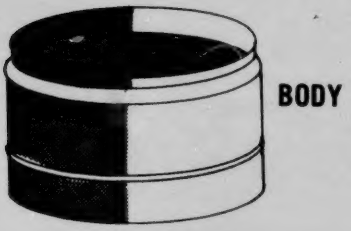


3. Remove and inspect filter for condition.
4. Replace as necessary.
5. Replace cover over filter.
6. Replace wing nut and tighten finger tight.

B. Wet or Oil Bath Type Filter

1. Remove wing nut at top of carburetor.
2. Lift off filter and housing.





3. Remove filter cover.
4. Remove filter gauze.
5. Empty oil from filter housing.
6. Clean filter housing and gauge.
7. Air-dry parts.
8. Refill housing with oil to oil quantity line marked on housing.
9. Replace filter gauge in housing.
10. Replace housing on carburetor.
11. Replace filter top.
12. Replace wing nut and tighten.
13. Close hood of vehicle.

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

UNIT TEST

1. Explain the purpose of the automotive fuel system.

2. Match the terms and definitions associated with the fuel system by placing the correct number to the left of each definition:

_____a.	Metal plates separating the fuel tank into sections, yet allowing fuel to pass slowly between them	1. Diaphragm
_____b.	Device used to measure quantity of fuel in the fuel tank	2. Baffles
_____c.	A device made of thin layers of cloth bound together with a special compound that makes it airtight and resistant to petroleum products	3. Liquidometer
_____d.	To go from a low speed to a high speed	4. Accelerate

3. Describe the construction of the fuel tank by underlining the correct answer for each of the following sentences:

   a. A metal container for the storage of (water, fuel).

   b. Contains (baffles, floats) to keep the fuel from shifting or sloshing.

   c. Contains a vent so that fuel may (be drawn out, evaporate).

   d. Has a (filler opening, drain plug) to allow fuel to enter the tank.

   e. Houses a liquidometer that gives an accurate description of the (rate of flow, amount) of gas in the tank.

4. Select the proper uses of fuel lines by writing true or false beside each of the following statements:

   ________a. Fuel lines are used to transmit fuel to the engine.

   ________b. Fuel lines are constructed of flexible rubber.

   ________c. Fuel lines are constructed of steel, approximately 5/16" in diameter.

5. Point out the operation of the fuel pump by underlining the correct answer for each of the following:

   a. Receives fuel from the fuel tank and (stores it for, sends it to) the carburetor

   b. A (diaphragm, siphon) type pump

   c. Driven by the (crankshaft, camshaft)

6. Locate the different fuel filters and explain the purpose of these filters by answering the following questions by underlining the correct answers:

   a. Fuel filters are located in which of the following?

      (1) in the tank at the fuel suction pick-up

      (2) in the gas-filler spout

      (3) in the engine manifold

      (4) in the fuel pump inlet

      (5) between the pump and carburetor

   b. The purpose of fuel filters is to:

      (1) remove air bubbles from the fuel

      (2) remove dirt and water from the fuel

7. Explain the operation of the carburetor by circling the correct answer for each of the following:

   a. A device that mixes fuel with (water, air, carbon dioxide) for entry into the engine

   b. Mixes fuel and air at a ratio of 13 parts (fuel, air) to 1 part (fuel, air)

c. Houses three fuel routes:

(1) idle circuit

(2) short circuit

(3) high-speed circuit

(4) acceleration circuit

8. Demonstrate the ability to:

a. Remove the fuel tank

b. Check out fuel tank indicating system

c. Replace liquidometer

d. Check fuel system for leakage and security

e. Remove and replace fuel pump

f. Clean fuel filter

g. Check and replace needle valve in carburetor

h. Adjust carburetor idle speed

i. Adjust carburetor fuel-air idle mixture

j. Remove and/or replace air filters

(NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT IV

FUEL SYSTEM OPERATION AND REPAIR

ANSWERS TO TEST

1. The purpose of the automotive fuel system is to store, transfer, and mix fuel and air for feeding into the engine during operation.

2.
__2__ a.
__3__ b.
__1__ c.
__4__ d.

3.
a. fuel
b. baffles
c. be drawn out
d. filler opening
e. amount

4.
__True__ a.
__False__ b.
__True__ c.

5.
a. sends it to
b. diaphragm
c. camshaft

6.
a. (1) in the tank at the fuel suction pick-up
   (2) in the fuel pump inlet
   (3) between the pump and carburetor
b. (2) remove dirt and water from the fuel

7.
a. air
b. air, fuel

c. (1) idle circuit
   (3) high-speed circuit
   (4) acceleration circuit

8. Evaluated to the satisfaction of the instructor.

UNIT V

ELECTRICAL SYSTEM

UNIT OBJECTIVE

After completion of this unit, the student will be able to explain the purpose of the electrical system and operation of the electrical system. The student will be able to find and repair OPEN and SHORTED circuits. The student will be able to wire series and parallel circuits. The knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the electrical system.
2. Match terms with definitions associated with the electrical system.
3. Select the terms describing each factor that determines electricity output.
4. Determine the types of currents produced in each different source.
5. Label circuits as series or parallel circuits.
6. Point out the parts of a battery.
7. Match the correct term with the electrical symbols used in electricity.
8. Demonstrate the ability to:
    - a. Point out various wiring circuits.
    - b. Draw auto wiring circuits from memory.
    - c. Draw series and parallel circuits.
    - d. Identify electrical symbols.
    - e. Test a light bulb.
    - f. Make splices in wire (conductor).

g. Solder wire.

h. Perform wiring tests.

i. Identify battery types and voltages.

j. Remove, clean, and replace battery.

k. Check battery with hydrometer.

l. Connect, operate, and disconnect a battery charger.

m. Perform a headlight draw test.

n. Magnetize a screwdriver.

UNIT V

ELECTRICAL SYSTEM

SUGGESTED ACTIVITIES

I. Instructor

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- C. Make transparencies.
- D. Discuss terminal and specific objectives.
- E. Discuss information sheet.
- F. Show and discuss transparencies.
- G. Hand out job sheets and discuss procedures.

  (NOTE: Electricity will be presented and studied with emphasis as applied to automobiles.)

- H. Give test.

II. Student

- A. Read objective sheet.
- B. Study information sheet.
- C. Demonstrate ability to perform work as outlined in job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    1. TM-1--Lighting Circuit
    2. TM-2--Series and Parallel Circuits

3. TM-3--Wiring Tests
4. TM-4--Electric Symbols
5. TM-5--Electric Light Bulb
6. TM-6--Soldering
7. TM-7--Battery (wet cell)
8. TM-8--Battery Test
9. TM-9--Battery Charger Connections

D. Assignment sheets

1. Assignment Sheet #1--Point Out Various Wiring Circuits
2. Assignment Sheet #2--Draw Auto Wiring Circuits
3. Assignment Sheet #3--Draw Series and Parallel Circuits
4. Assignment Sheet #4--Identify Electrical Symbols

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1--Test Light Bulb
2. Job Sheet #2--Make Splices in Wire (conductor)
3. Job Sheet #3--Solder Wire
4. Job Sheet #4--Perform Wiring Tests
5. Job Sheet #5--Identify Battery Types and Voltages
6. Job Sheet #6--Remove, Clean, and Replace Battery
7. Job Sheet #7--Check Battery with Hydrometer
8. Job Sheet #8--Connecting, Operating, and Disconnecting a Battery Charger
9. Job Sheet #9--Perform Headlight Draw Test
10. Job Sheet #10--Magnetize Screwdriver

G. Test

H. Answers to test

II. References:

A. Stockel, Martin W. Auto Mechanics Fundamentals. South Holland, Illinois: Goodheart-Wilcox Company Inc., 1974.

B. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: Goodheart-Wilcox Company Inc., 1974.

UNIT V

ELECTRICAL SYSTEM

INFORMATION SHEET

I. The purpose of any electrical system is to furnish a source of power (electrical), to establish paths (circuits) through control devices (switches), and to operate units (motors) within a given system.

II. Terms and definitions

   A. Electricity--The flow of electrons under pressure through a wire

   B. Wire--A coated strand of metal through which electricity flows

   C. Switch--A device for opening or closing the path through which electricity flows

   D. Solder--A soft metal that melts easily; used to weld wires together

   E. Bulb--A unit in the electrical system designed to give off light

   F. Filament--The fine wire inside the light bulb

   G. Frame--The structure of the automobile to which the body is bolted

   H. Resistance--A force applied by types of metals in an electrical system that slows down the flow of electricity

   I. Atom--A basic unit which, when in combination with other units, makes up molecules

   J. Molecules--The smallest particles of a substance or material

   K. Fuse--A unit located in a wire to relieve an overloan in the electrical system before a wire burns up

   L. Circuit breaker--A reusable unit located in a wire to prevent an overload in the electrical system circuit before the wire burns up

M. Circuit--The path through which electricity flows

N. Conductor--A wire through which electricity flows

O. Hydrometer--A device used to check the electrolyte condition of individual battery cells

P. Continuity test--Checking a wire to see if it will allow the proper current to flow through it by connecting an ohmmeter to each end of the wire

III. Factors determining electricity output

A. Amperage--The rate of current flow of electricity

B. Ohm--The measure of resistance to the flow of electricity

C. Voltage--The pressure with which electricity is forced through a wire

IV. Types of current

A. DC--Direct current as supplied by batteries; flows in one direction

B. AC--Alternating current as used in home electric systems; changes directions

V. Types of circuits

A. Series circuit--Where the units within the circuit are located one after another so that the current has to pass through each unit to get to the next

B. Parallel circuit--A circuit wired to allow power to all units at the same time

VI Storage battery

A. Battery--A storage place for electricity where chemical energy is converted into electrical energy

B. Cells--A part of the battery containing 2 volts

C. Electrolyte--The liquid used in the battery which is made up of water and sulfuric acid

D. Positive post--The plus side of the battery where the electricity returns to the battery.

(NOTE: It is the largest post, which will have a + (plus) on its top and will be painted red.)

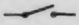
E. Negative post--The minus side of the battery where electricity leaves the battery through a circuit to all the units.

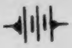
(NOTE: It is the smallest post, which will have a - (minus) on top and will be painted green.)

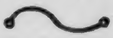
VII. Electrical symbols

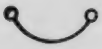
A. Ohms Ω

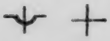
B. Ground ⏚

C. Switch 

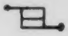
D. Battery (6-volt) 

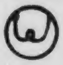
E. Fuse 

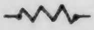
F. Circuit breaker 

G. Wires crossed but not connecting 

H. Wires connecting +

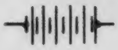
I. Contact points 

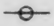
J. Lamp 

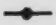
K. Resistor 

L. Positive +

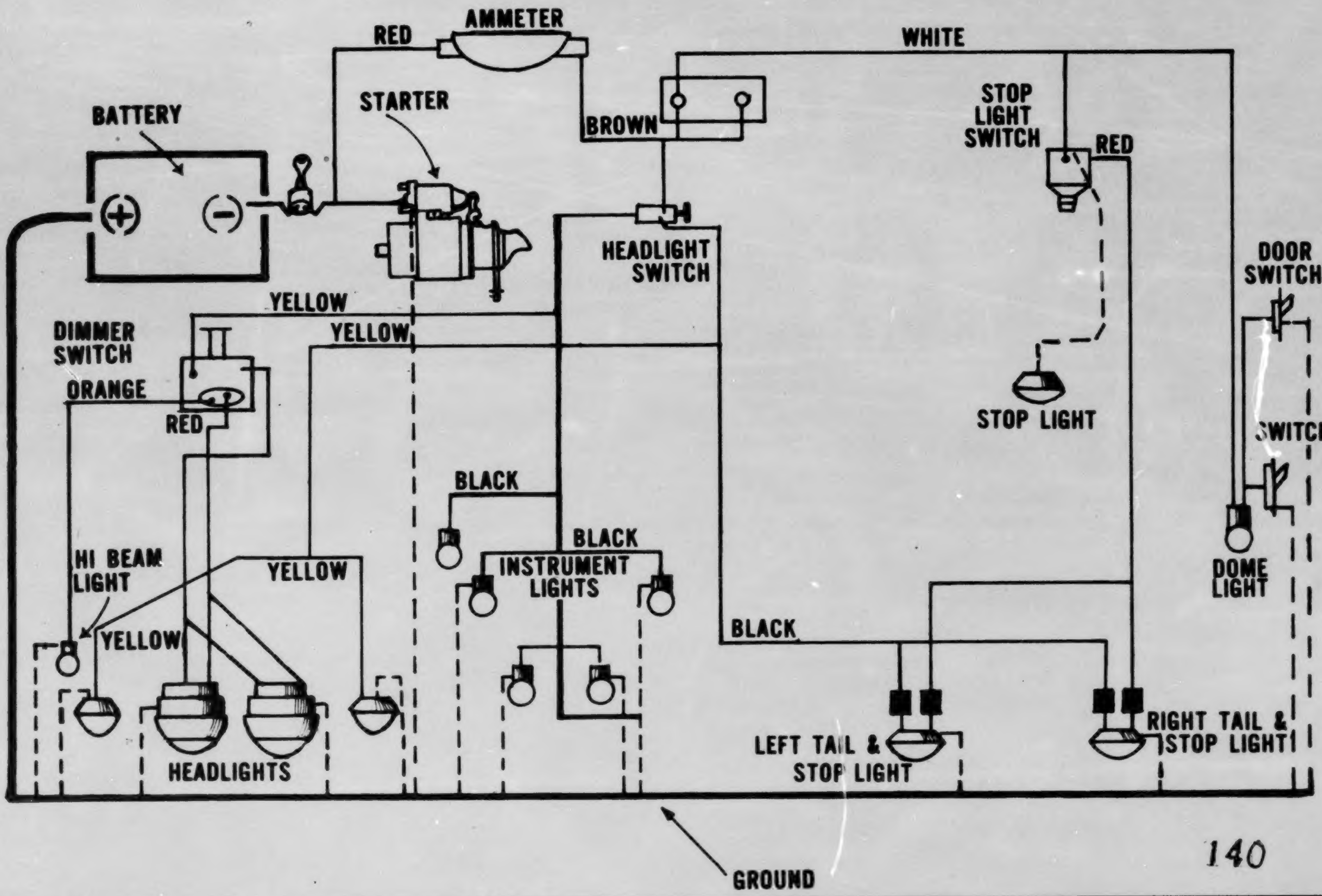
M. Negative —

N. Battery (12-volt) 

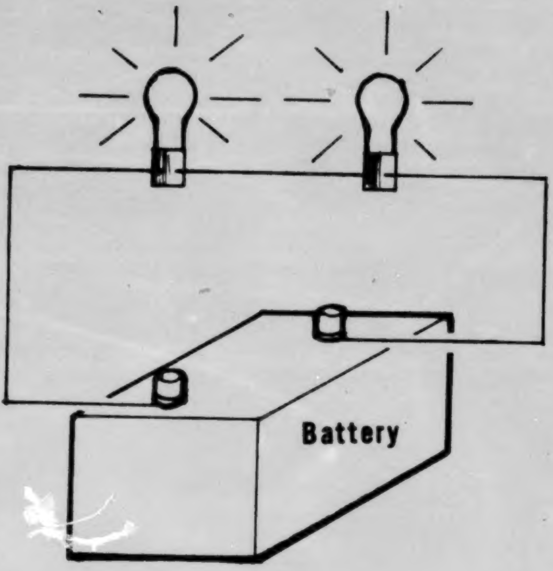
O. Terminal 

P. Splice 

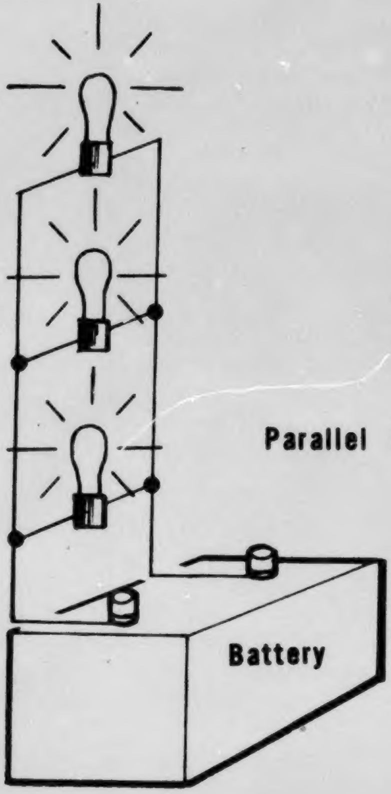
LIGHTING CIRCUIT


AMMETER
RED
WHITE
STARTER
BATTERY
BROWN
STOP LIGHT SWITCH
RED
(+)
(−)
HEADLIGHT SWITCH
DOOR SWITCH
YELLOW
DIMMER SWITCH
YELLOW
ORANGE
STOP LIGHT
RED
SWITCH
BLACK
BLACK
HI BEAM LIGHT
INSTRUMENT LIGHTS
YELLOW
DOME LIGHT
YELLOW
BLACK
RIGHT TAIL & STOP LIGHT
LEFT TAIL & STOP LIGHT
HEADLIGHTS
GROUND

SERIES AND PARALLEL CIRCUITS

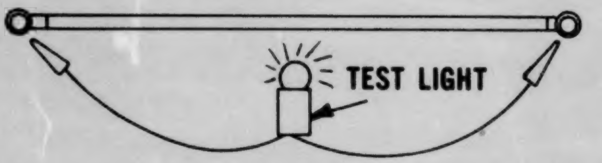


Series Circuit

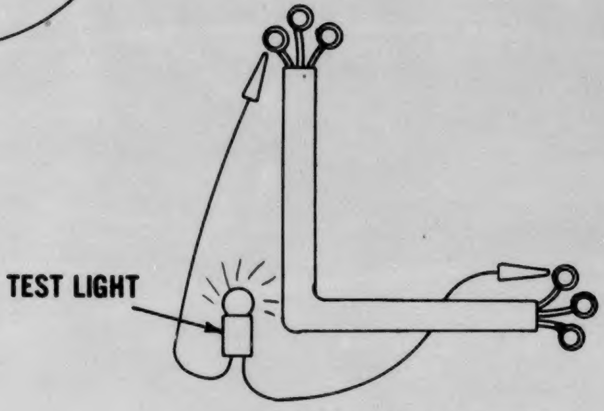


Parallel Circuit

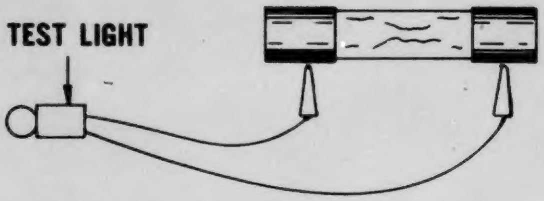
WIRING TESTS



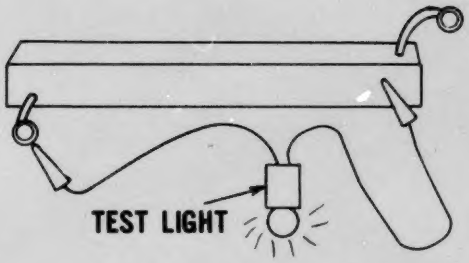
A. TESTING A WIRE



B. LOCATING A CIRCUIT

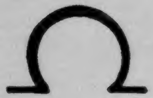


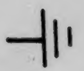
C. CHECKING A FUSE

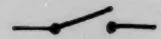


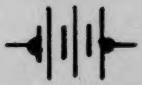
D. CHECKING FOR GROUND

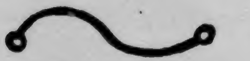
ELECTRICAL SYMBOLS

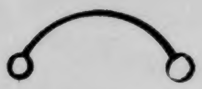

(1) OHM

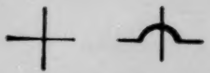

(2) GROUND

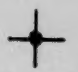

(3) SWITCH

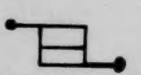

(4) BATTERY
(6 VOLT)

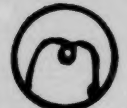

(5) FUSE

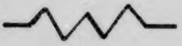

(6) CIRCUIT BREAKER

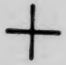

(7) WIRES CROSSED
NOT CONNECTED

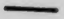

(8) WIRES
CONNECTING

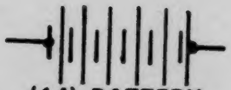

(9) CONTACT
POINTS

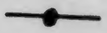

(10) LAMP

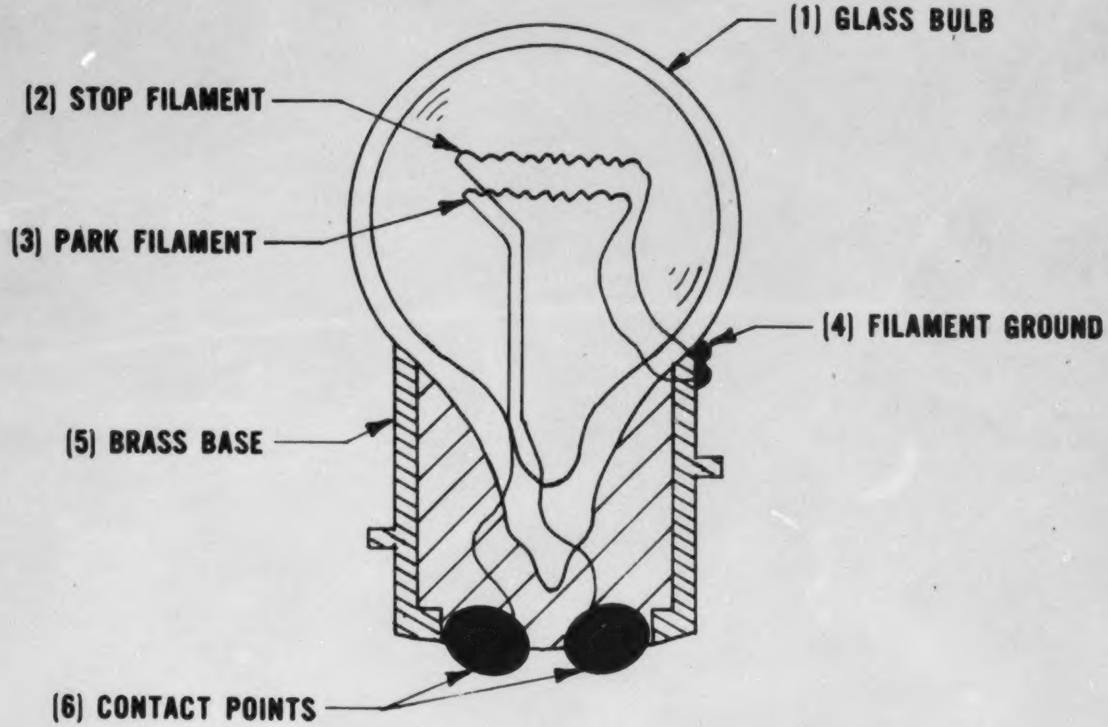

(11) RESISTOR


(12) POSITIVE


(13) NEGATIVE


(14) BATTERY
(12 VOLT)

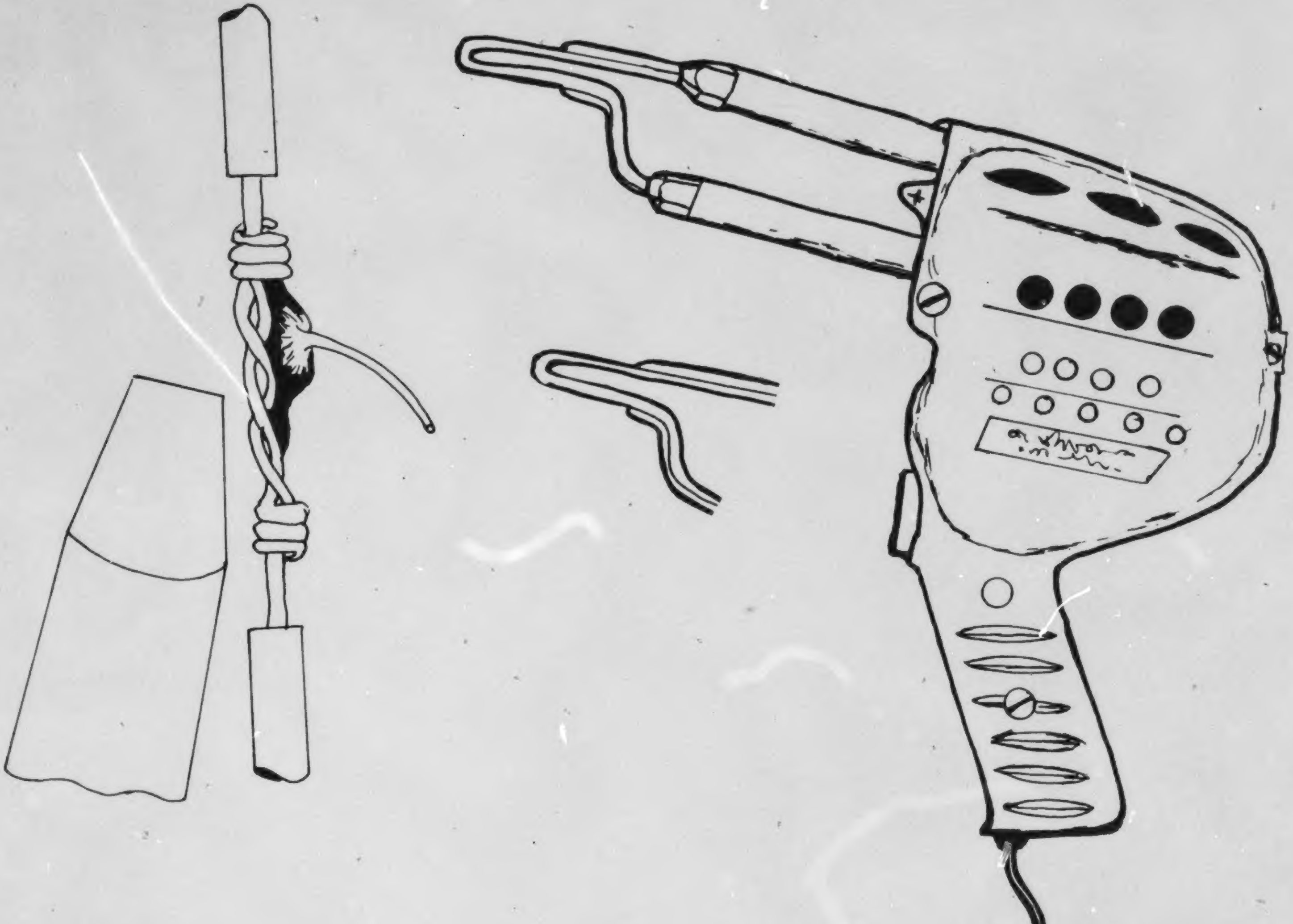

(15) SPLICE


(1) GLASS BULB
(2) STOP FILAMENT
(3) PARK FILAMENT
(4) FILAMENT GROUND
(5) BRASS BASE
(6) CONTACT POINTS

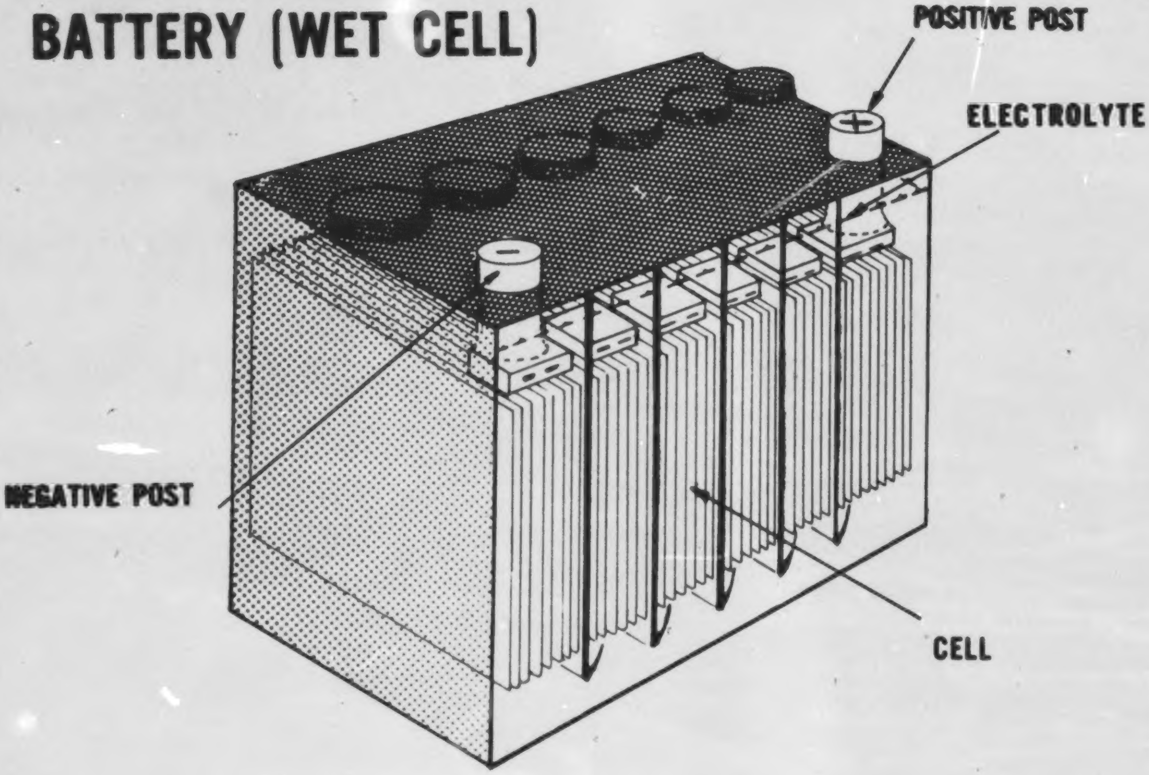
ELECTRIC LIGHT BULB

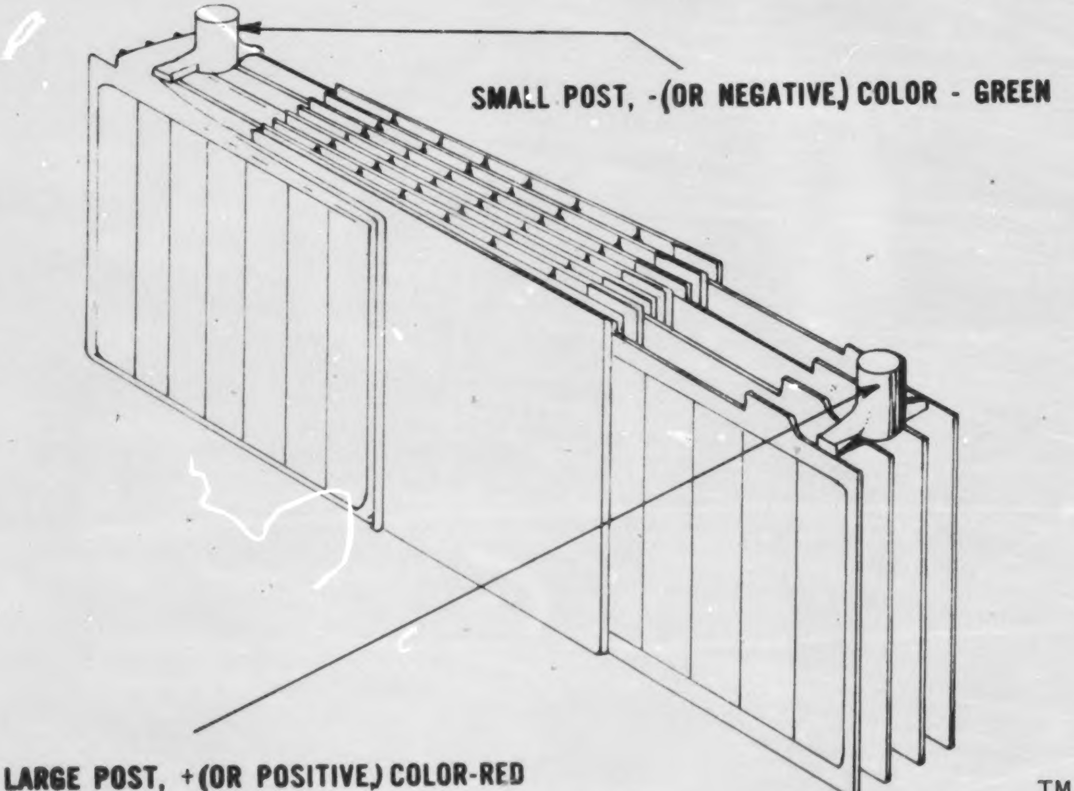
TM-5

SOLDERING

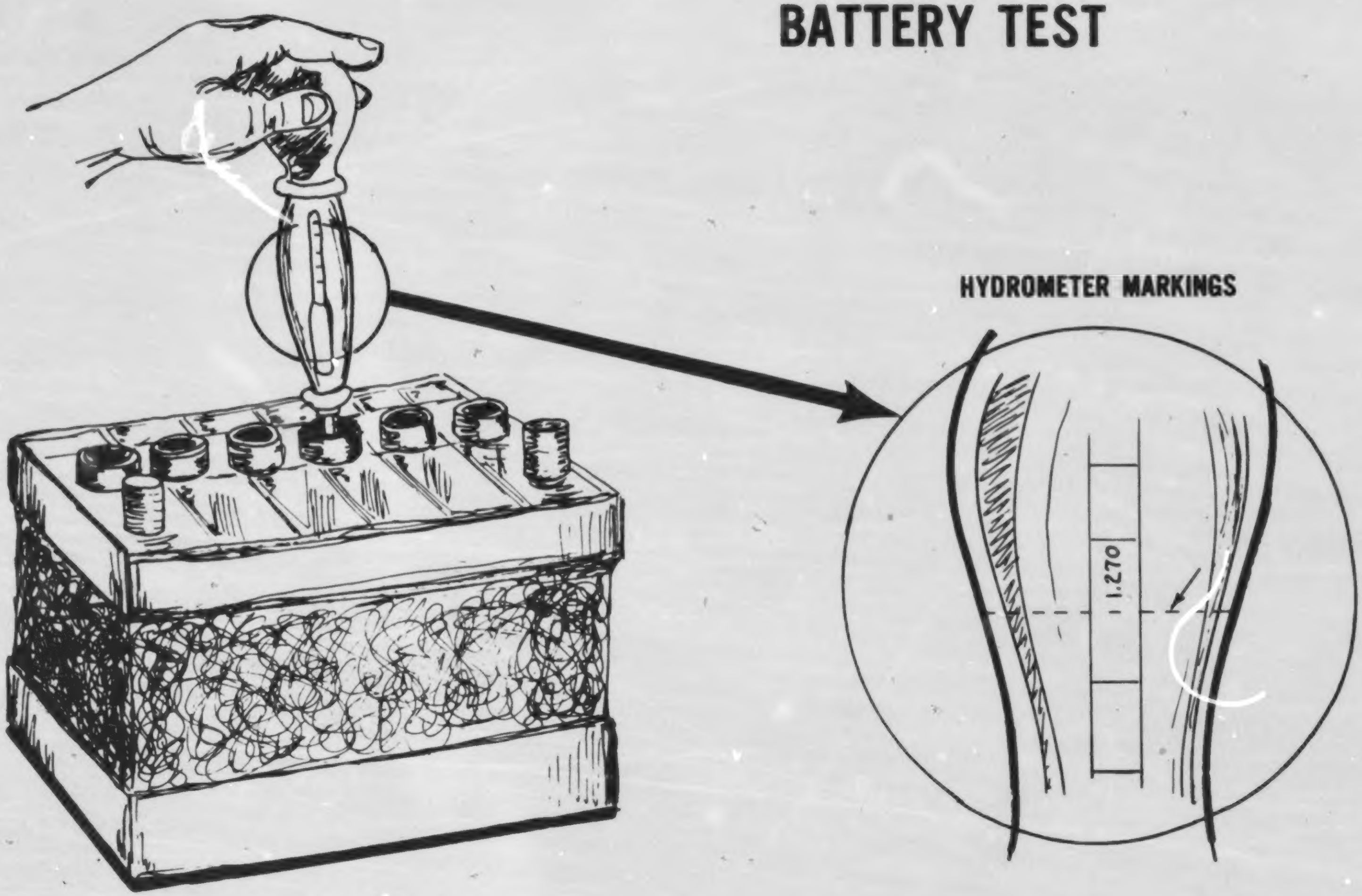


BATTERY (WET CELL)

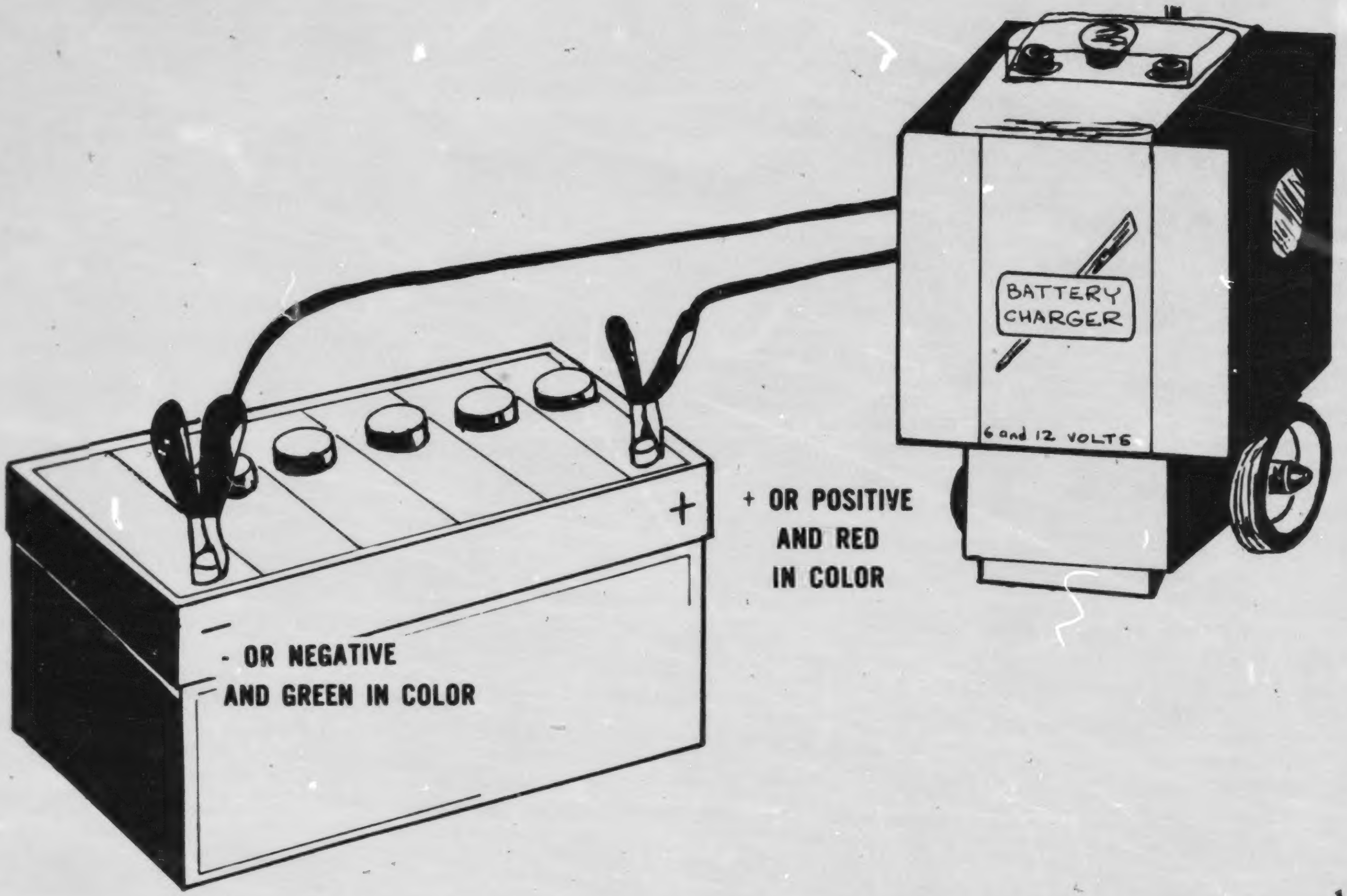

POSITIVE POST
ELECTROLYTE
NEGATIVE POST
CELL


SMALL POST, -(OR NEGATIVE) COLOR - GREEN
LARGE POST, +(OR POSITIVE) COLOR-RED

BATTERY TEST


HYDROMETER MARKINGS
1.270

BATTERY CHARGER CONNECTIONS


BATTERY CHARGER
6 and 12 VOLTS
+
−

+ OR POSITIVE
AND RED
IN COLOR

- OR NEGATIVE
AND GREEN IN COLOR

UNIT V

ELECTRICAL SYSTEM

ASSIGNMENT SHEET #1--POINT OUT VARIOUS WIRING CIRCUITS

Show the location of the following parts or circuits of the electrical system of a vehicle or display. (Note: Use a pointer to show the following locations.)

1. The electrical path from the battery to the dome light and back to the battery
2. The electrical path from the battery to the stop light and back to the battery
3. The electrical path from the battery to the headlight and back to the battery
4. The electrical path from the battery to the parklight and back to the battery
5. The location of the fuse in the dome light circuit
6. The location of the switch in the stoplight circuit
7. The location of the ground symbol on the headlight circuit
8. The location of the wires that cross and touch on the parklight system

UNIT V

ELECTRICAL SYSTEM

ASSIGNMENT SHEET #2--DRAW AUTO LIGHTING CIRCUIT

Draw the following electrical system parts and connect with a line to indicate the wire routes.

1. On an 8 1/2" x 11" sheet of paper draw the following:
    a. Headlights
    b. Parklights
    c. Tail lights
    d. Dome light
2. Draw the following on the paper:
    a. Headlight switch
    b. Dimmer switch
    c. Stop light switch
    d. Dome light switch
    e. Fuses
3. Draw a battery using the correct symbol.
4. Draw a frame and label with the printed word FRAME.
5. Draw fuses between each switch and unit.
6. Connect the parts in the correct order to and from the battery.

UNIT V

ELECTRICAL SYSTEM

ASSIGNMENT SHEET #3--DRAW SERIES AND PARALLEL CIRCUITS

Draw each of the electrical parts below in the type of circuit pointed out and connect with a line representing the route of electricity.

1. Draw a series circuit showing and connecting the following:
    a. Power source
    b. Wires
    c. Switch
    d. Fuse
    e. Three light bulbs
2. Draw a parallel circuit showing and connecting the following:
    a. Power source
    b. Wires
    c. Switch
    d. Fuse
    e. Three light bulbs

UNIT V

ELECTRICAL SYSTEM

ASSIGNMENT SHEET #4--IDENTIFY ELECTRICAL SYMBOLS

Draw the symbols for the following terms from memory or the transparency:

1. Ohms
2. Ground
3. Switch
4. Battery (6-volt)
5. Fuse
6. Circuit breaker
7. Wires crossed, not connected
8. Wires connecting
9. Contact points
10. Lamp
11. Resistor
12. Positive
13. Negative
14. Battery (12-volt)
15. Splice

UNIT V

ELECTRICAL SYSTEM

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Evaluated to the satisfaction of the instructor.

Assignment Sheet #2

Evaluated from transparency TM-1.

Assignment Sheet #3

Evaluated from transparency TM-2.

Assignment Sheet #4

Evaluated from transparency TM-4

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #1--TEST LIGHT BULB

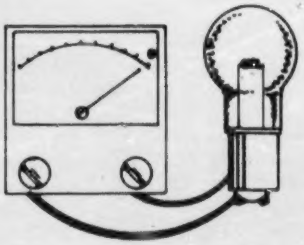
I. Equipment required

- A. Ohmmeter (set on ohms)
- B. Good light bulb (two-terminal)
- C. Burned-out light bulb (two-terminal)

II. Procedure

A. Connect ohmmeter to brass base of burned-out light bulb and to one base-connector terminal.

(NOTE: No reading indicates that filament is burned out.)



B. Change lead to other base terminal connector.

(NOTE: No reading indicates other filament is burned out.)

C. Connect ohmmeter to brass base of good light bulb and one to base-connector terminal.

(NOTE: Any reading indicates that filament is good.)

D. Change lead to other base terminal connector.

(NOTE: Any reading indicates other filament is good.)

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #2--MAKE SPLICES IN WIRE (CONDUCTOR)

I. Tools and materials required

  A. A piece of #18 gauge coated wire 4 feet long

  B. Wire stripper

  C. Diagonal pliers

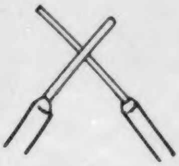
II. Procedure

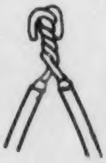
  A. Use diagonal pliers and cut wire into four equal-length pieces.

  B. Strip approximately 1 inch of coating off the ends of all four pieces of wire.

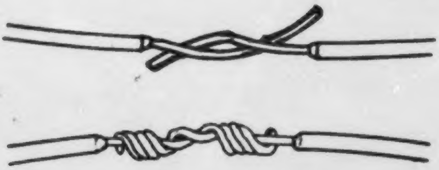
  C. All frayed ends should be twisted individually until smooth.

  D. Using one piece of wire, complete a "pigtail" splice.



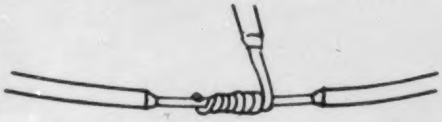


  E. Using one piece of wire, complete a "western union" splice.



  F. Using two pieces of wire, complete a "tap" splice.

  (NOTE: Present all work to instructor for evaluation.)



UNIT V

ELECTRICAL SYSTEM

JOB SHEET #3--SOLDER WIRE

I. Tools and materials required

- A. Diagonal pliers
- B. A piece of #18-gauge wire - 12 inches long
- C. Wire strippers
- D. Soldering gun
- E. Solder (rosin core)
- F. Electrical source (110 volts)

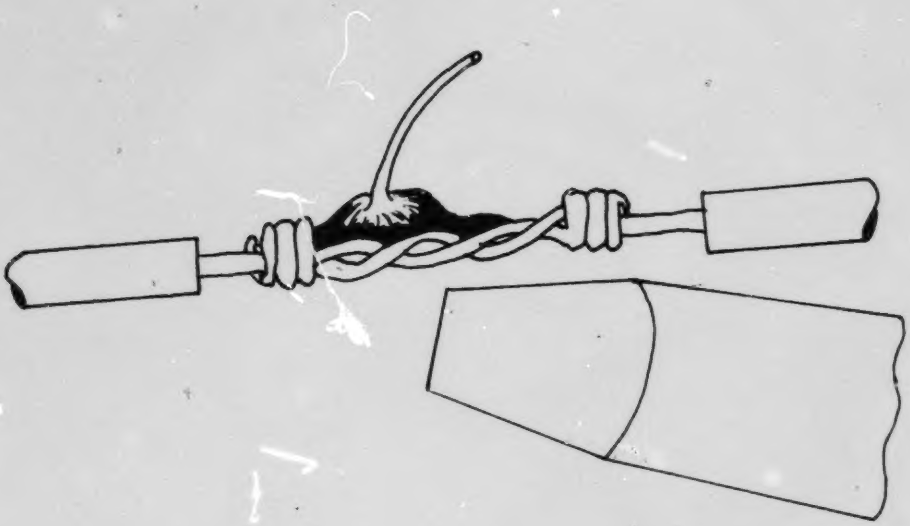
II. Procedure

- A. Cut 12" piece of #18-gauge wire from roll using diagonal pliers.
- B. Strip approximately 1 inch of coating off each end of wire.
- C. Twist ends of wire counterclockwise until even.
- D. Make a "western union splice".

  (NOTE: Splice should be no more than 1/2 inch long when completed.)
- E. Plug in soldering iron.
- F. "Tin" tip of iron when hot.

  (CAUTION: Care should be used when iron is hot to avoid burns to skin.)
- G. Place soldering iron under bottom of splice.
- H. Add solder (rosin core) to top of wire.

  (NOTE: When wire becomes hot enough, solder will flow down through splice.)



I. Remove iron and let splice cool.

(NOTE: Re-apply heat if too much solder remains on splice.)

J. Present to instructor for evaluation.

K. Clean area and tools.

L. Return all tools to tool room.

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #4--PERFORM WIRING TESTS

I. Tools and materials

A. Ohmmeter

B. Wire mockups

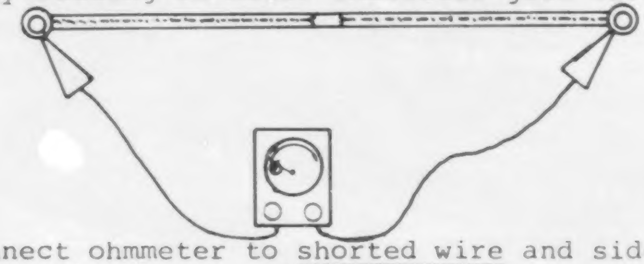
1. Open wire (wire broken under coating)
2. Shorted wire (grounded in metal tube)
3. Identify wire (3 wires wrapped)
4. Two fuses (1 good; 1 blown)

II. Procedure

A. Connect ohmmeter to both ends of an open wire.

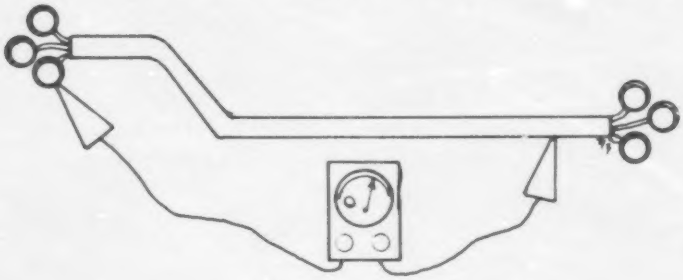
B. Set meter on highest ohm reading on selector.

(NOTE: No reading on meter indicates open in wire. Any reading on meter indicates good wire.)



C. Connect ohmmeter to shorted wire and side of tube or block through which it passes.

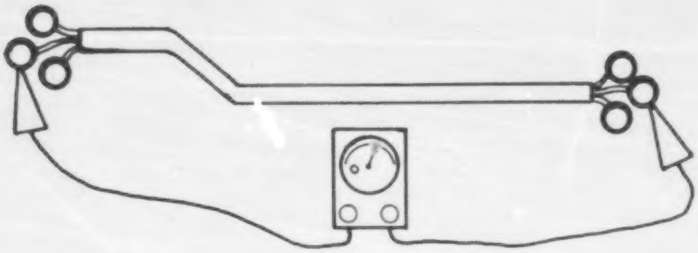
(NOTE: No reading indicates wire is not shorted. Any reading indicates short to ground.)



D. Connect ohmmeter to each end of the wire through the tube or block.

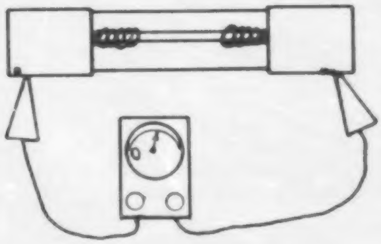
E. Read meter individually as ends of one wire are touched.

(NOTE: Any reading indicates that wire is continuous.)



F. Touch ohmmeter leads to end of fuse.

(NOTE: No reading indicates fuse is blown or open. Any reading indicates fuse is good.)



UNIT V

ELECTRICAL SYSTEM

JOB SHEET #5--IDENTIFY BATTERY TYPES AND VOLTAGES

I. Materials required

A. One 12-volt battery (wet cell)

B. One 6-volt battery (wet cell)

C. Six 1 1/2-volt batteries (dry cell)

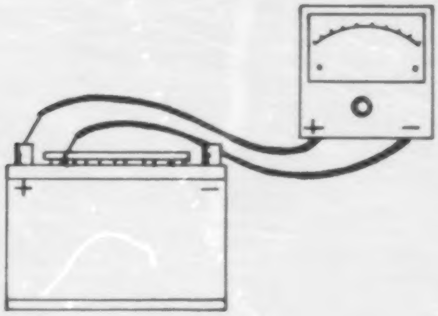
D. Voltmeter

II. Procedure

A. Identify on both 6- and 12-volt batteries:

1. Cell
2. Cap
3. Positive post
4. Case
5. Negative post

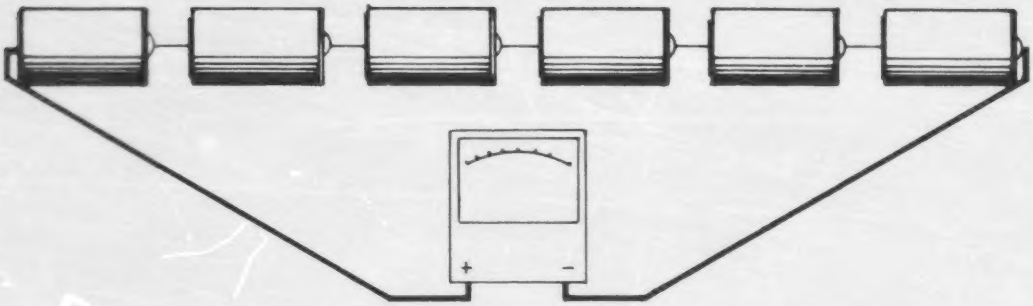
B. Connect a voltmeter to one cell of a battery.



C. Check the voltage of one cell on each battery.

D. Check the voltage of the entire battery of cells on both batteries.

E. Connect six dry-cell batteries in series and check the voltage.



UNIT V

ELECTRICAL SYSTEM

JOB SHEET #6--REMOVE, CLEAN, AND REPLACE BATTERY

I. Tools and materials required

   A. 1/2" x 9/16" open-end wrench

   B. Soda and water solution

   C. Terminal cleaner

   D. Bearing grease

   E. Battery lifting strap

II. Procedure

   A. Raise hood as applicable.

   B. Remove terminals with 1/2" x 9/16" wrench as required.

   C. Remove battery; hold down straps with wrench.

   D. Secure battery straps to terminals, if applicable.

   (NOTE: Put large hole in strap to PLUS post and small hole in strap to NEGATIVE post.)

   E. Lift battery out of car.

   (WARNING: Do not let battery come into contact with clothing.)

   F. Place battery on work table.

   (NOTE: Never place battery on concrete floor as it will discharge battery.)

   G. Check and fill cells with good, clean tap water to cover cell plates.

   H. Clean posts with terminal cleaner.

   I. Clean outside battery case with soda and water solution.

   J. Apply a light coat of bearing grease to battery posts.

K. Reinstall battery strap to battery.

L. Replace battery in car.

M. Remove lifting strap.

N. Install hold-down strap on battery.

O. Replace cables to terminals.

(NOTE: Place POSITIVE lead first to large post, NEGATIVE lead second to small post with open-end wrench.)

P. Close hood.

Q. Clean area and tools.

R. Return tools to tool room.

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #7--CHECK BATTERY WITH HYDROMETER

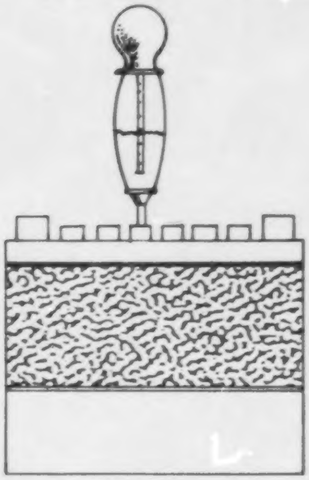
I. Tools and materials required

- A. Hydrometer
- B. Battery (wet cell)

II. Procedure

- A. Raise hood
- B. Remove battery caps
- C. Pull up sufficient amount of electroyte into hydrometer to float bulb in liquid.

  (NOTE: Hold hydrometer vertical.)



- D. Read scale for cell condition.

  NOTE: General readings:

Fully charged	1.300 reading
Good charge	1.275 reading
Medium charge	1.215 reading
Low charge	1.175 reading
No charge	1.120 reading

(Correction of readings according to temperature should be made.)

E. Replace caps.

F. Close hood.

G. Clean area.

H. Return tools to tool room.

(NOTE: If battery requires charging, do so in accordance with Job Sheet #8.)

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #8--CONNECT, OPERATE, AND DISCONNECT A BATTERY CHARGER

I. Tools and materials required

A. 3/8" socket set

B. Battery charger

II. Procedure

A. Raise hood.

B. Remove battery caps.

C. Use liquidometer and check condition of battery.

D. Remove battery cables with socket set.

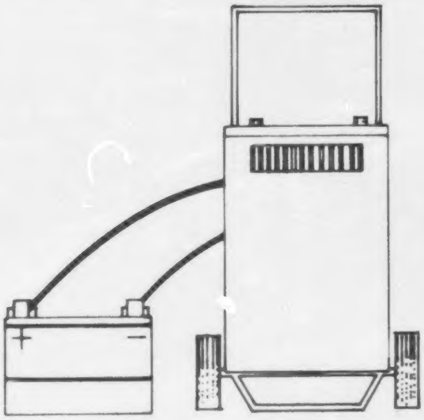
E. Determine type of battery.

(Example: 6-volt or 12-volt)

F. Check electrolyte level in battery.

G. Connect charger to battery.

(NOTE: Place red charger lead to positive post, black lead to negative post.)



H. Select 6 or 12 volts on charger selector.

I. Plug battery charger into 110-volt outlet.

J. Turn battery charger ON.

K. Using amperage selector on charger, select low, medium, or high charge as required.

L. Check with hydrometer for enough charge.

M. When battery is charged, turn battery charger OFF.

N. Disconnect battery charger cables, negative lead first.

O. Replace car battery cables to battery--postive lead first--and secure with socket set.

P. Replace battery filler caps (if removed).

Q. Close hood.

R. Roll up all leads to battery charger.

S. Clean work area.

T. Return tools to tool room.

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #9--PERFORM HEADLIGHT DRAW TEST

I. Tools required

Voltmeter (.01 volt scale)

II. Procedure

A. Raise hood

B. Place transmission in park or neutral and set parking brake.

C. Disconnect the coil wire to the distributor to keep the engine from starting.

D. Crank engine for about three seconds.

E. Turn headlights on low beam.

F. Test cells with voltmeter, with lights on.

(NOTE: See Job Sheet #5 for procedures.)

1. If cells differ more than .05 volts, battery is defective.
2. A reading of 1.95 volts per cell indicates battery is good.
3. A reading of less than 1.95 per cell indicates battery needs charging.

G. Turn off headlights.

H. Replace coil to distributor wire.

I. Close hood.

J. Clean work area as required.

K. Return equipment to tool room.

UNIT V

ELECTRICAL SYSTEM

JOB SHEET #10--MAGNETIZE SCREWDRIVER

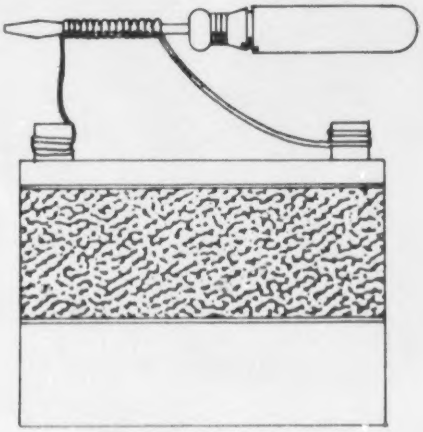
I. Tools and materials required

- A. Screwdriver (not magnetized)
- B. Six feet of #18 gauge coated wire
- C. 12-volt battery (charged)
- D. Diagonal pliers

II. Procedure

- A. Strip 1/4" of coating from each end of a six-foot piece of #18 gauge wire.
- B. Wrap wire around screwdriver shank, leaving 10 inches on either end uncoiled.
- C. Touch the bare ends of the wire to positive and negative terminal posts on battery for three seconds.

(WARNING: Do not hold on battery too long since wire will heat up.)



D. Remove wire from battery terminals and attempt to pick up metal objects.

E. Return tools and materials to proper location.

UNIT V

ELECTRICAL SYSTEM

UNIT TEST

1. Explain the purpose of the electrical system.

2. Match terms with definitions associated with the electrical system.

_____a. The flow of electrons under pressure through a wire

_____b. A coated strand of metal through which electricity flows

_____c. A device for opening or closing the path through which electricity flows

_____d. A soft metal that melts easily, which is used to weld wires together

_____e. A unit in the electrical system designed to give off light

_____f. The fine wire inside the light bulb

_____g. The structure of the automobile to which the body is bolted

_____h. A force applied by types of metals in an electrical system that slows down the flow of electricity

_____i. A basic unit which, when in combination with other units, makes up molecules

_____j. The smallest particle of a substance or material

1. Molecule
2. Frame
3. Bulb
4. Solder
5. Resistance
6. Switch
7. Atom
8. Wire
9. Filament
10. Electricity

_____k. A unit located in a wire to relieve an overload in the electrical system

_____l. A reusable unit located in a wire to relieve an overload in the electrical system before the wire burns up

_____m. The path through which electricity flows

_____n. A wire through which electricity flows

_____o. A device used to check the electrolyte condition of individual battery cells

_____p. Checking a wire to see if it will allow the proper current to flow through it by commecting an ohmmeter to each end of the wire

12. Circuit

13. Hydrometer

14. Circuit breaker

15. Fuse

16. Conductor

17. Continuity test

3. Select the terms describing each factor that determines electricity output by placing the correct letter to the left of each letter.

_____a. The rate of flow of electricity

_____b. The measure of resistance to the flow of electricity

_____c. The pressure with which electricity is forced through a wire

1. Ohm

2. Voltage

3. Amperage

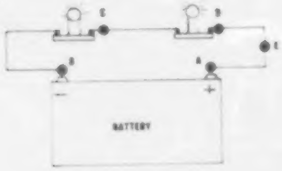
4. Determine the type of current (AC or DC) produced in each of the different sources.

_______a. Current supplied by batteries

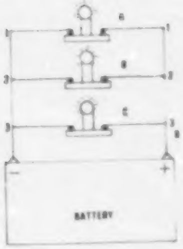
_______b. Current used in home electrical systems

5. Label each circuit as series or parallel circuits.

______________________ a.



______________________ b



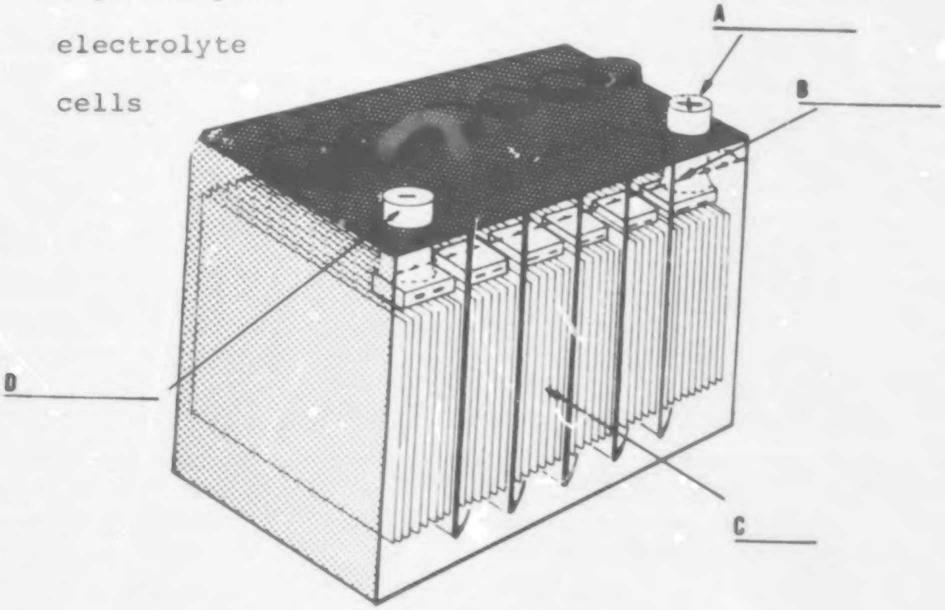
6. Point out the parts of a battery by labeling each of numbered parts with one of the following:

positive post

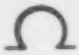
negative post

electrolyte

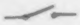
cells

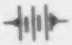


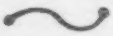
7. Match the correct term with the electrical symbols used in electricity.

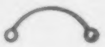
_____a. 

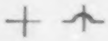
_____b.

_____c. 

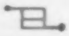
_____d. 

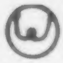
_____e. 

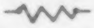
_____f. 

_____g. 

_____h. +

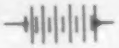
_____i. 

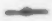
_____j. 

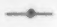
_____k. 

_____l. +

_____m. −

_____n. 

_____o. 

_____p. 

1. Lamp
2. Fuse
3. Positive
4. Splice
5. Battery (6-volt)
6. Ohms
7. Terminal
8. Ground
9. Contact points
10. Battery (12-volt)
11. Switch
12. Wires connecting
13. Negative
14. Circuit breaker
15. Resistor
16. Wires crossed, not connecting

8. Demonstrate the ability to:

   a. Point out various wiring circuits.

   b. Draw auto wiring circuits from memory.

   c. Draw series and parallel circuits.

   d. Identify electrical symbols.

   e. Test a light bulb.

   f. Make splices in wire (conductor).

   g. Solder wire.

h. Perform wiring tests.

i. Identify battery types and voltages.

j. Remove, clean, and replace battery.

k. Check battery with hydrometer.

l. Connect, operate, and disconnect a battery charger

m. Perform a headlight draw test.

n. Magnetize a screwdriver.

(NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT V

ELECTRICAL SYSTEM

ANSWERS TO TEST

1. The purpose of any electrical system is to furnish a source of power (electrical), to establish paths (circuits) through control devices (switches), and to operate units (motors) with a given system.

2. a. 5
   b. 1
   c. 6
   d. 4
   e. 3
   f. 2
   g. 9
   h. 12
   i. 10
   j. 7
   k. 11
   l. 8
   m. 14
   n. 13
   o. 15
   p. 16

3. a. 3
   b. 1
   c. 2

4. a. Direct current
   b. Alternating current

5. a. Series
   b. Parallel

6. a. Positive post
   b. Electrolyte
   c. Cells
   d. Negative post

7. a. 6
b. 8
c. 11
d. 5
e. 2
f. 14
g. 16
h. 12
i. 9
j. 1
k. 15
l. 3
m. 13
n. 10
o. 7
p. 4

8. Evaluated to the satisfaction of the instructor.

UNIT VI

IGNITION SYSTEM

UNIT OBJECTIVE

After completion of this unit, the student will be able to explain the operation of the ignition system. The student will be able to visually inspect, test, and service the ignition system. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the ignition system.
2. Match the term to the correct definition associated with the ignition system.
3. Match the terms associated with the components of the ignition system with the correct description of each.
4. Match the correct term with each of the component parts of the distributor.
5. Match the correct term to each of the spark plug conditions.
6. Match the names of the correct testing equipment with the function of each.
7. Demonstrate the ability to:
    a. Change spark plugs.
    b. Change breaker points and condenser.
    c. Change spark plug wires.
    d. Inspect distributor cap.
    e. Use the dwell meter.
    f. Use the timing light.
    g. Use the voltmeter.

UNIT VI

IGNITION SYSTEM

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheets.

  B. Provide students with information and job sheets.

  C. Make transparencies.

  D. Discuss unit and specific objectives.

  E. Discuss information and job sheets.

  F. Demonstrate and discuss procedures outlined on job sheets.

  G. Give unit test.

II. Student:

  A. Read objective sheet.

  B. Study information sheet.

  C. Complete each job sheet.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheets

    1. Information Sheet #1--Ignition System Terminology

    2. Information Sheet #2--The Ignition System

  C. Transparency masters

    1. TM-1--Cutaway View of Coil

    2. TM-2--Cutaway View of Distributor

3. TM-3--Breaker Points
4. TM-4--Cutaway View of Spark Plug
5. TM-5--Spark Plug Fouling
6. TM-6--Servicing Spark Plug
7. TM-7--Servicing Breaker Points
8. TM-8--Spark Plug Wires
9. TM-9--Distributor Cap
10. TM-10--Dwell Meter
11. TM-11--Timing
12. TM-12--Voltmeter

D. Job sheets

1. Job Sheet #1--Change Spark Plugs
2. Job Sheet #2--Change Breaker Points and Condenser
3. Job Sheet #3--Change Spark Plug Wires
4. Job Sheet #4--Inspect Distributor Cap
5. Job Sheet #5--Use the Dwell Meter
6. Job Sheet #6--Use the Timing Light
7. Job Sheet #7--Use the Voltmeter

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: The Goodheart-Wilcox Co., Inc., 1975.

B. Stockel, Martin W. Auto Mechanic Fundamentals. South Holland, Illinois: The Goodheart-Wilcox Co., Inc., 1974.

UNIT VI

IGNITION SYSTEM

INFORMATION SHEET #1--IGNITION SYSTEM TERMINOLOGY

I. The purpose of the ignition system is to supply and distribute high-voltage sparks that ignite the fuel-air mixture within the combustion chamber.

II. Terms and definitions

A. Battery--A storage place for electricity where chemical energy is converted into electrical energy

B. Circuit--The path through which electricity flows

C. DC Current--Current, as that supplied by batteries, which flows in one direction only

D. Fuse--A unit located in a wire or circuit to prevent an overload in the electrical system before the wire burns up

E. Ground--The connection of an electrical unit to the engine or frame to return current to its source

F. High tension--A term used for high voltage

G. Ignition--Process of setting fire to fuel in the combustion chamber by means of a spark

H. Magnet--Body of metal that has the ability to attract

I. Ohm--The measure of resistance to the flow of electricity

J. Pre-igniting--The fuel-air mixture ignites or burns before it should

K. Relay--A magnetically operated switch used to make and break the flow of current in a circuit

L. Short circuit--A hot wire in the electrical system that has become grounded

M. Resistor--A device placed in a circuit to lower voltage

N. BDC--Bottom dead center is the position of the piston when it reaches its lower limit of travel in the cylinder

O. TDC--Top dead center is the position of the piston when it reaches the highest limit of travel in the cylinder

P. Firing order--The order in which the cylinders must be fired

Q. Flashover--An arcing of electricity in the ignition system at a place where the insulation has become faulty

UNIT VI

IGNITION SYSTEM

INFORMATION SHEET #2--THE IGNITION SYSTEM

III. Components of the ignition system

A. Battery--A storage place for electricity where chemical energy is converted into electrical energy

B. Starter relay--A switch in the cranking device or an engine

C. Ignition switch--A device used for opening and closing all electrical circuits on an automobile

D. Ballast resistor--A resistor made of a wire which will increase or decrease voltage as the heat of the wire changes

E. Coil--A unit used to step up battery voltage to a point necessary to fire a spark plug

F. Distributor--A unit designed to make and break the main ignition circuit and to distribute the resulting high voltage to the proper cylinder at the right time

G. Spark plug--A device with two electrodes which provides an air gap for a spark to jump across and ignite the fuel-air mixture in the combustion chamber

IV. Components of the distributor

A. Distributor cap--An insulated cap in which voltage travels from a central terminal to a circular series of terminals through the rotor

B. Rotor--A unit placed on one end of the distributor shaft that takes the voltage from the coil and delivers it to each one of the cap terminals

C. Cam--A moving part, of irregular or lobed form, that moves or alters the motion of another part

D. Vacuum advance--Unit that moves the ignition timing ahead and back by means of the vacuum produced by the engine

E. Breaker points--A pair of movable points that open and close the circuit in a distributor

F. Condenser--A device between the points and coil that temporarily stores a surge of current that can be discharged as the points close

V. Conditions of spark plugs

A. Fuel fouling--Plug deposited with black, dry carbon caused either by the plugs being too cold, a high level of fuel in the carburetor, excessive choking, or a clogged air cleaner

B. Oil fouling--Plugs covered with wet, black deposits caused by an excessive amount of oil reaching the combustion chamber

C. Splashed fouling--New plugs coated with splashes of carbon deposits because the plugs were installed in an engine that had heavy deposits of carbon in the combustion chamber

D. Aluminum throw-off--A plug fouled with particles of molten aluminum, caused by the piston breaking up due to rapid combustion, pre-ignition, or over-advanced ignition timing

E. Shell bridging--A plug with a large piece of piston or combustion chamber deposit sticking between the hot insulator and plug shell

F. Gap bridging--A plug with carbon-lead deposits connecting the two electrodes

G. High-speed glazing--A plug with a hard, shiny, yellowish-tan deposit caused by a sudden increase in plug temperature during hard acceleration or loading

VI. Testing equipment used in checking the ignition system

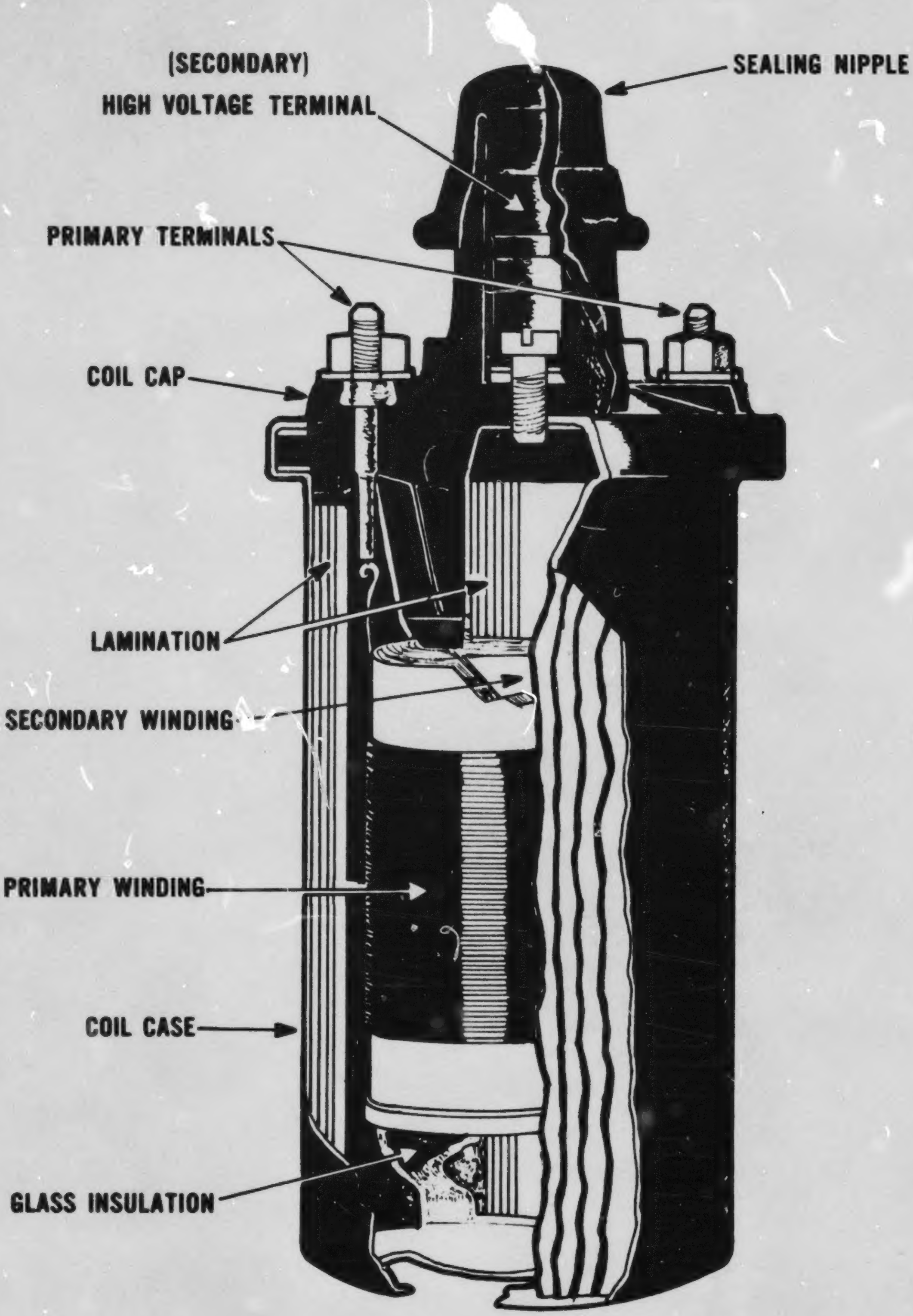
A. Thickness gauge--A device used for checking the gap on spark plugs or points, measuring in thousandths

B. Dwell meter--A testing instrument that measures the dwell angle or the number of degrees the distributor cam rotates from the time the points open until they close

C. Timing light--A unit connected to the engine ignition system which produces flashes of light in with the firing of the No. 1 spark plug

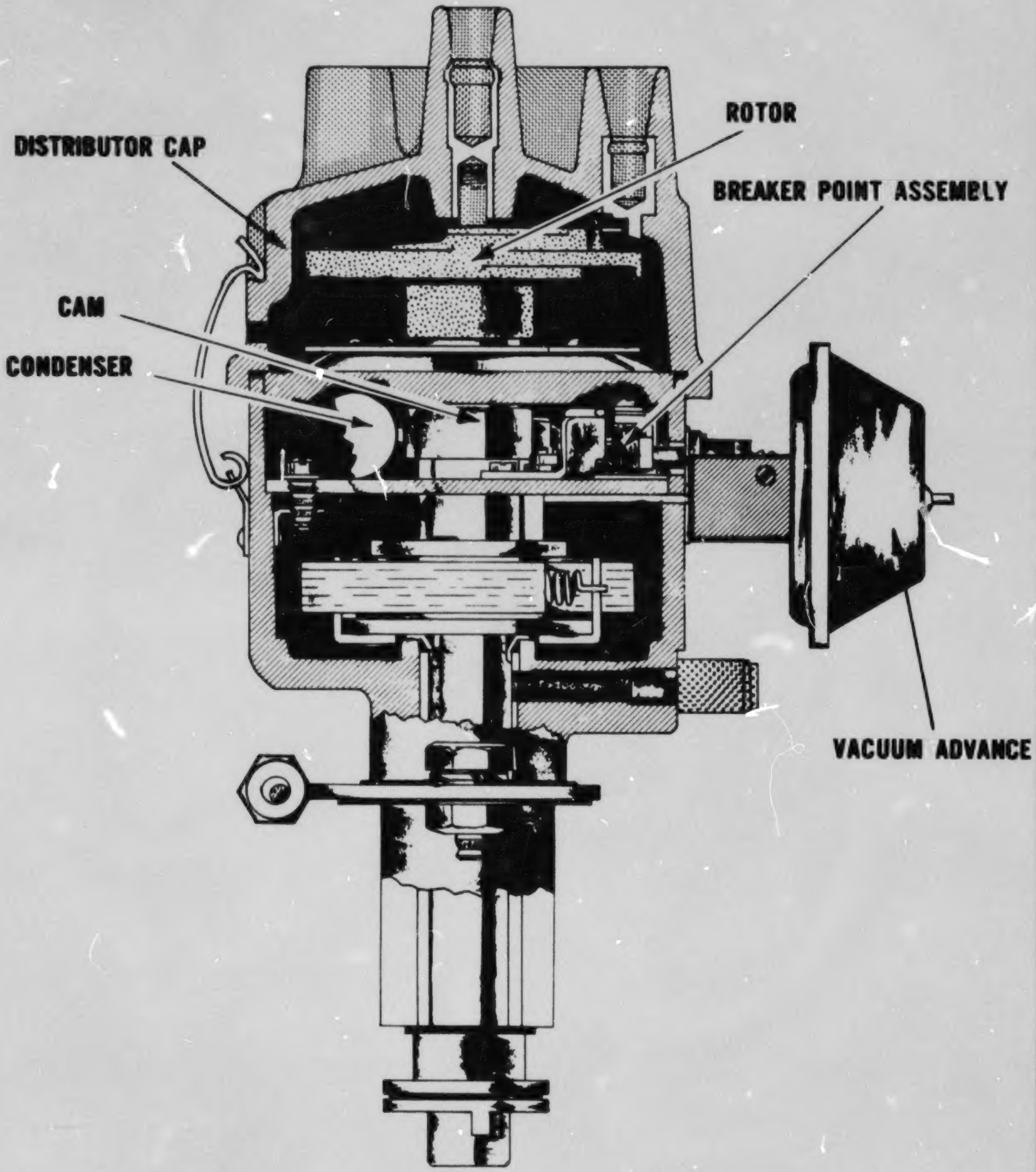
D. Voltmeter--An instrument used to measure volts in a circuit

CUTAWAY VIEW OF A COIL

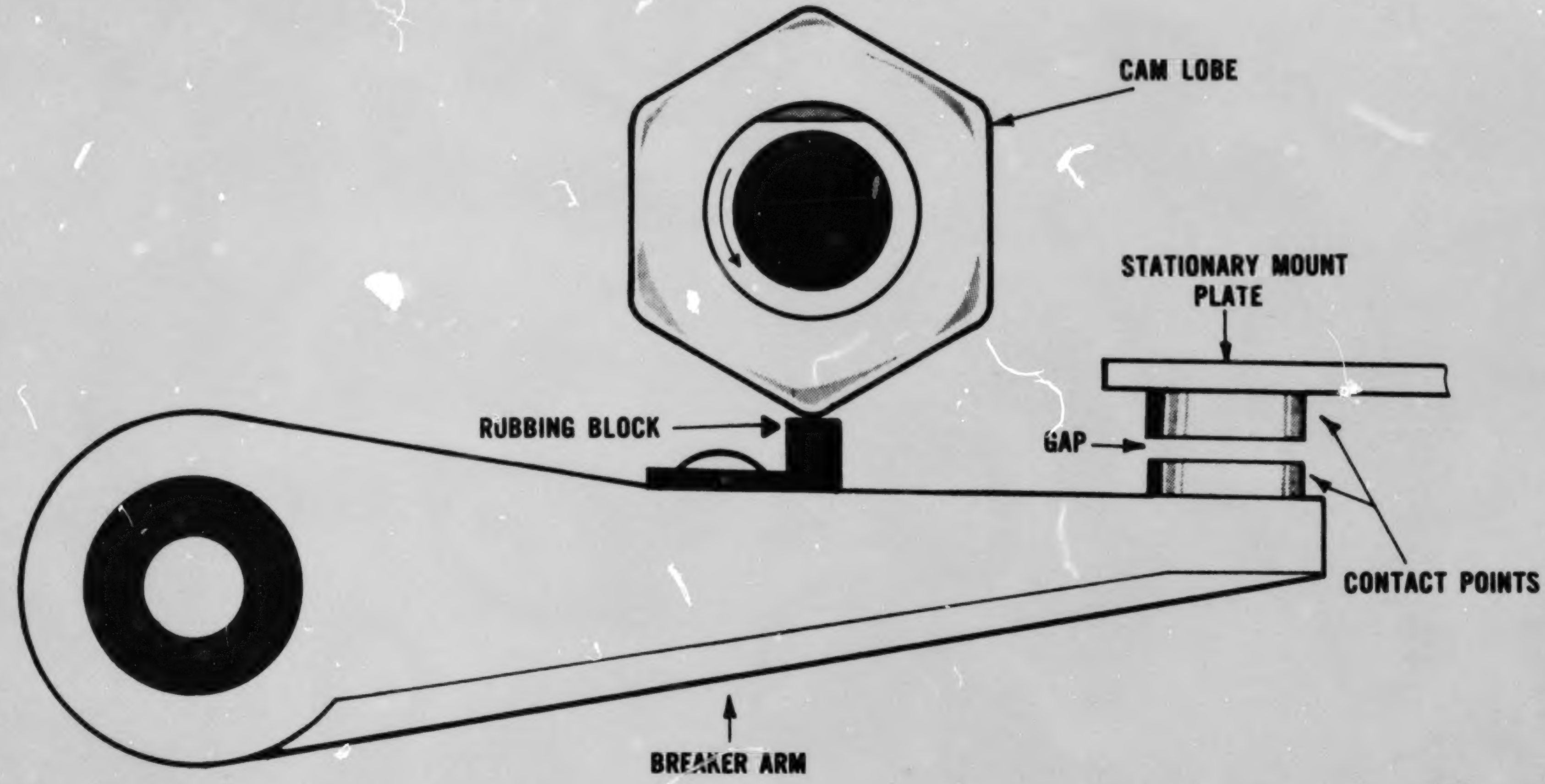

(SECONDARY)
HIGH VOLTAGE TERMINAL
SEALING NIPPLE
PRIMARY TERMINALS
COIL CAP
LAMINATION
SECONDARY WINDING
PRIMARY WINDING
COIL CASE
GLASS INSULATION

TM-1

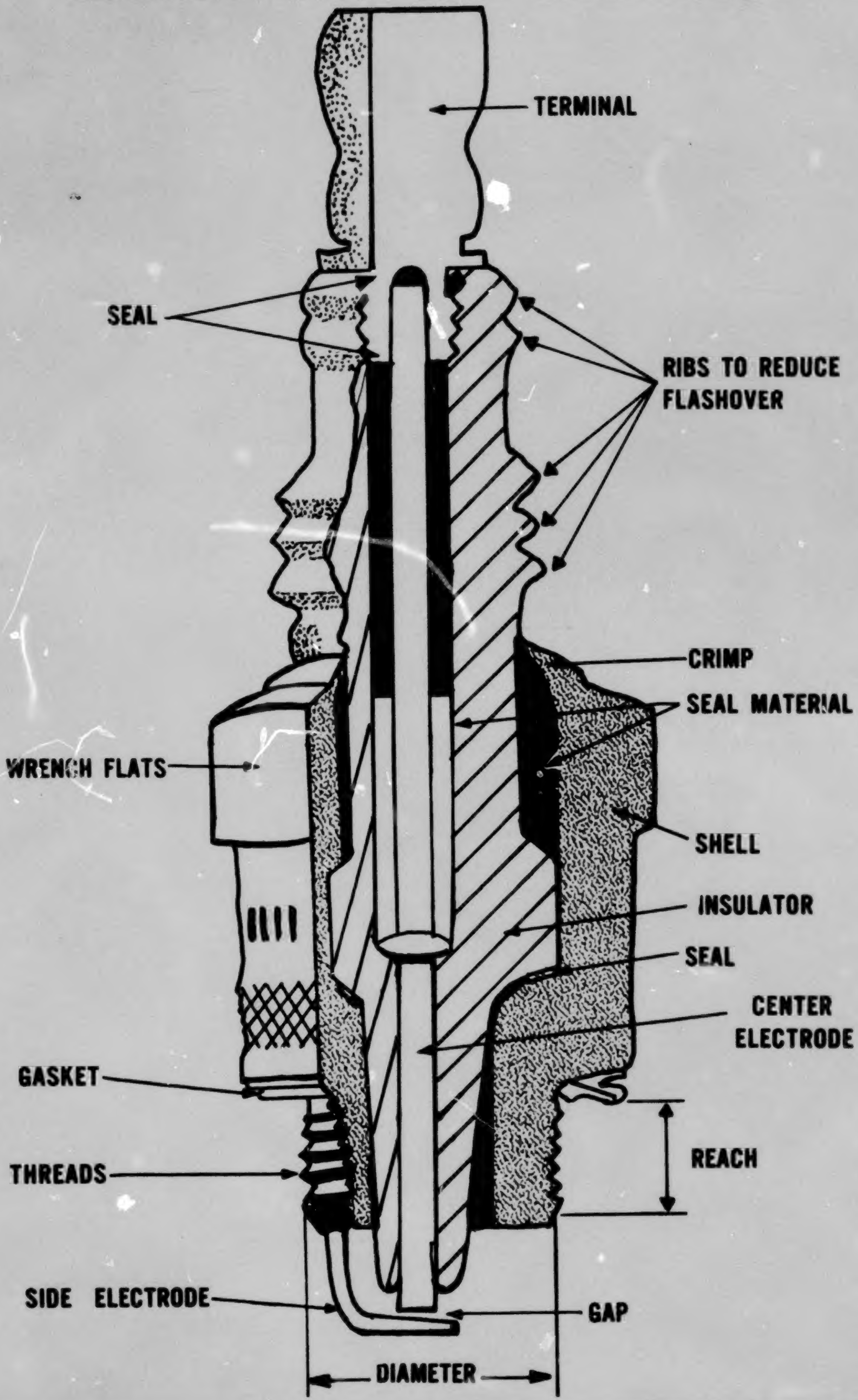
CUTAWAY VIEW OF DISTRIBUTOR


DISTRIBUTOR CAP
ROTOR
BREAKER POINT ASSEMBLY
CAM
CONDENSER
VACUUM ADVANCE

BREAKER POINTS

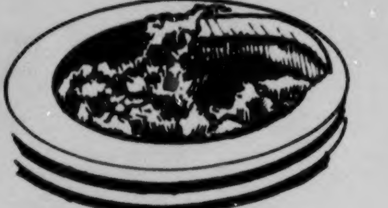

CAM LOBE
STATIONARY MOUNT PLATE
RUBBING BLOCK
GAP
CONTACT POINTS
BREAKER ARM

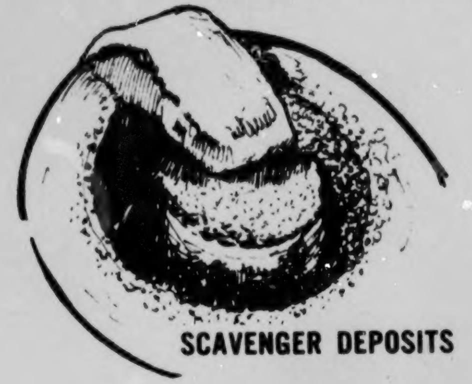
CUTAWAY VIEW OF A SPARK PLUG

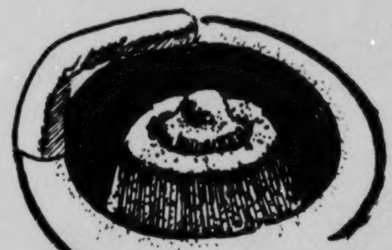

TERMINAL
SEAL
RIBS TO REDUCE FLASHOVER
CRIMP
SEAL MATERIAL
WRENCH FLATS
SHELL
INSULATOR
SEAL
CENTER ELECTRODE
GASKET
REACH
THREADS
SIDE ELECTRODE
GAP
DIAMETER

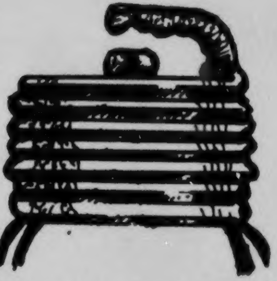
TM-4

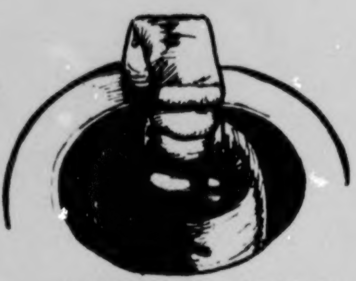
SPARK PLUG FOULING

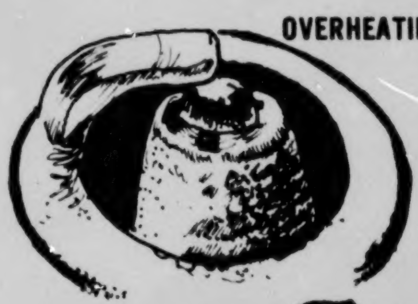

ALUMINUM THROWOFF

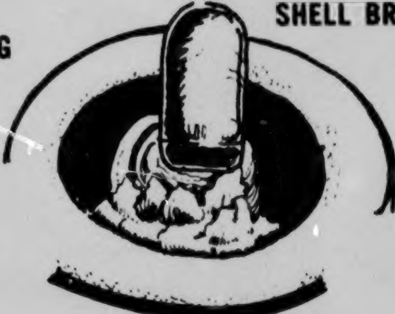

SCAVENGER DEPOSITS

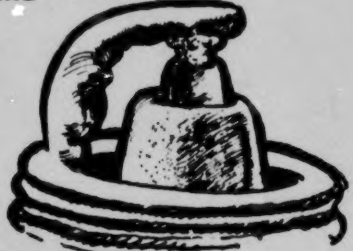

TURBULENCE BURNING

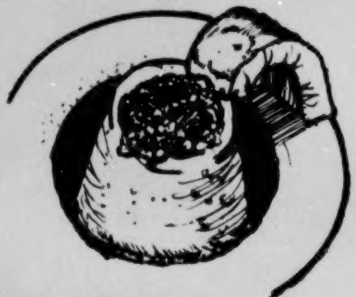

REVERSED COIL POLARITY

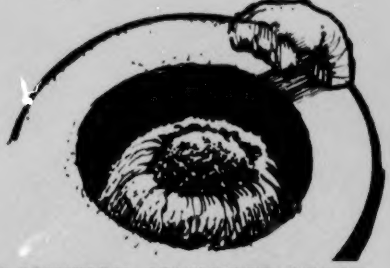

HIGH-SPEED GLAZING

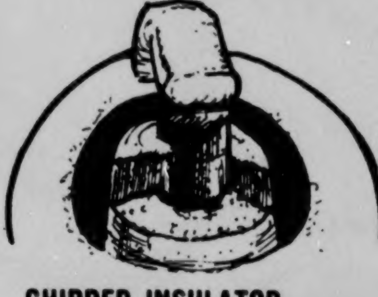

OVERHEATING

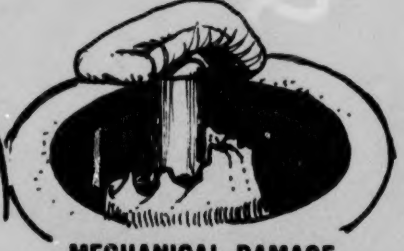

SHELL BRIDGING


GAP BRIDGING

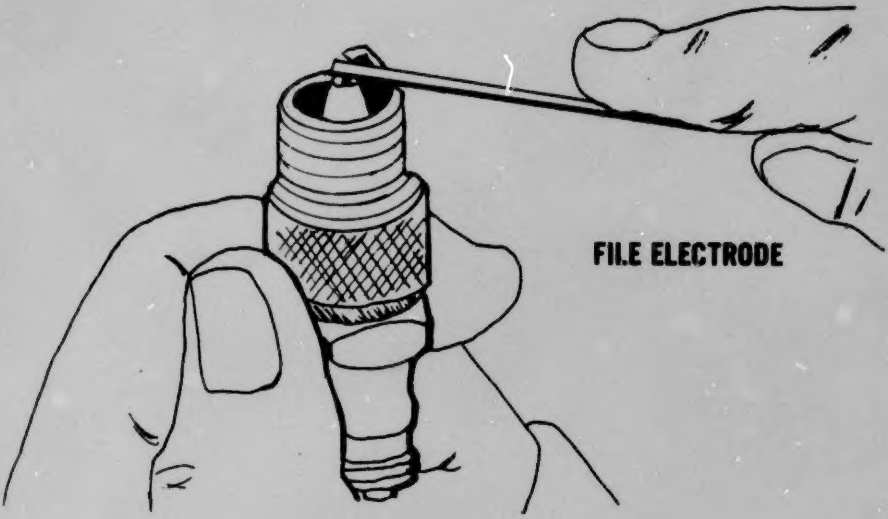

PRE-IGNITION

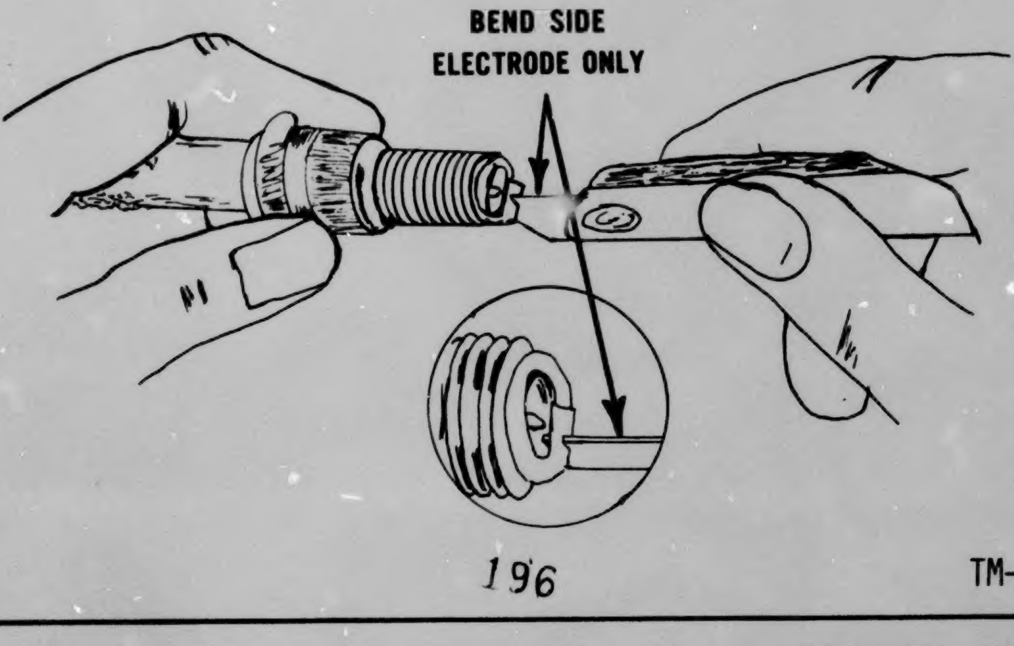

PRE-IGNITION ADVANCED STAGE


CHIPPED INSULATOR

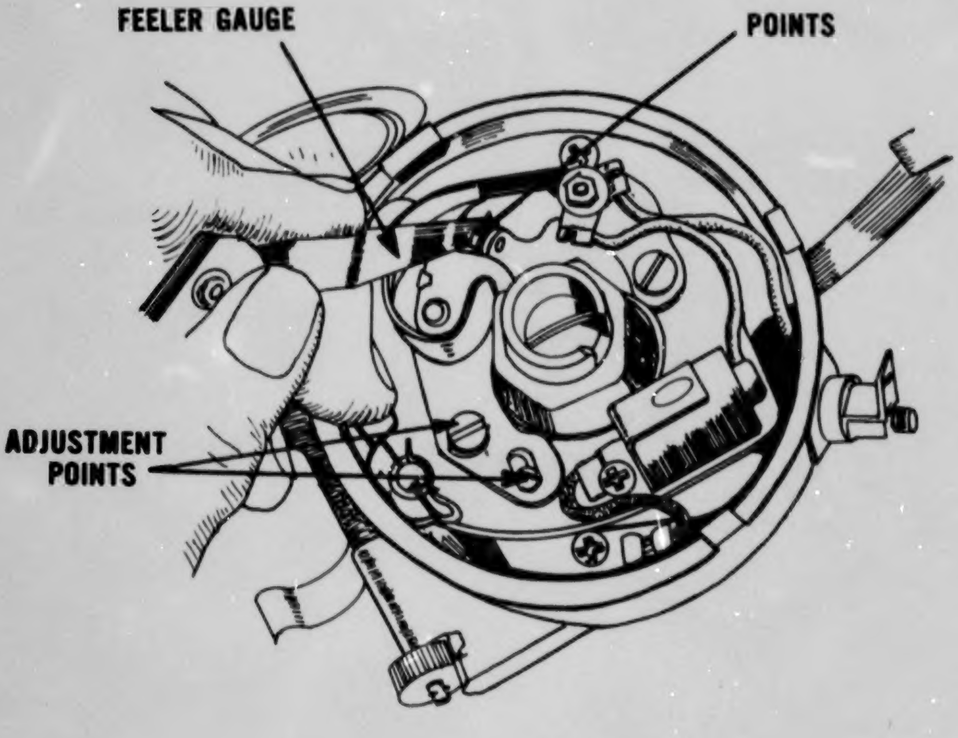

MECHANICAL DAMAGE

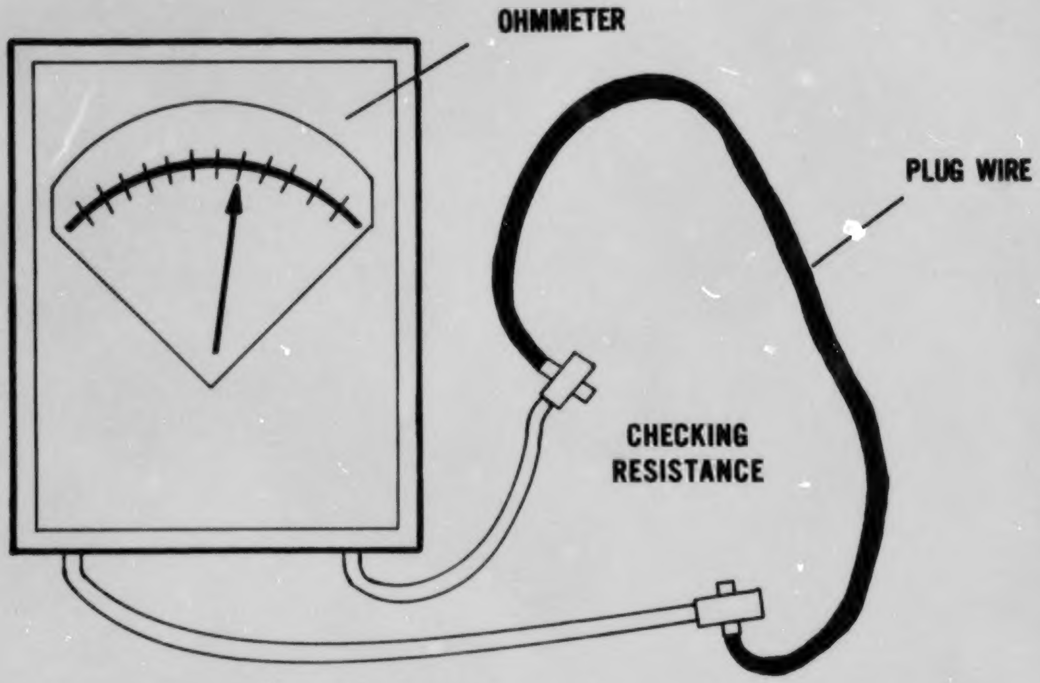
SERVICING SPARK PLUGS


FILE ELECTRODE

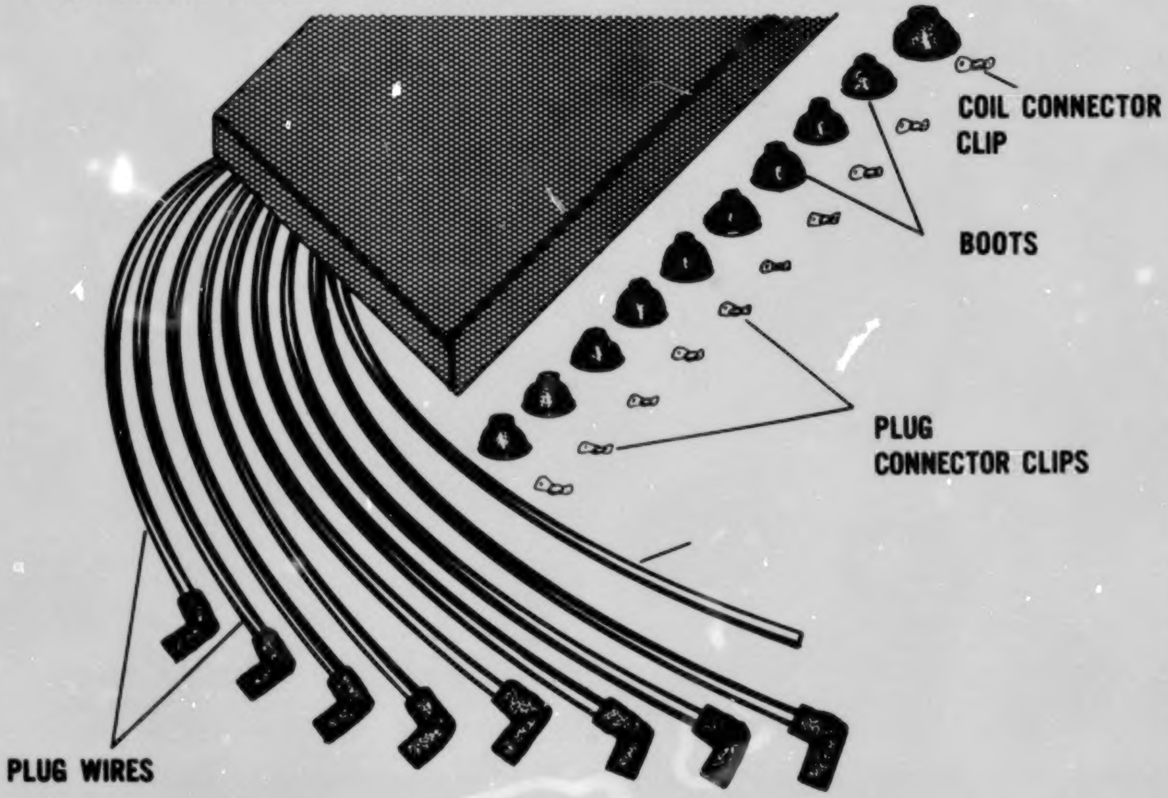

BEND SIDE
ELECTRODE ONLY

SERVICING BREAKER POINTS

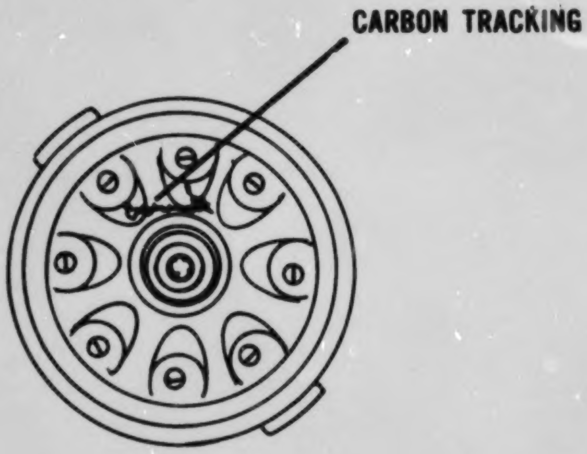

FEELER GAUGE
POINTS
ADJUSTMENT POINTS

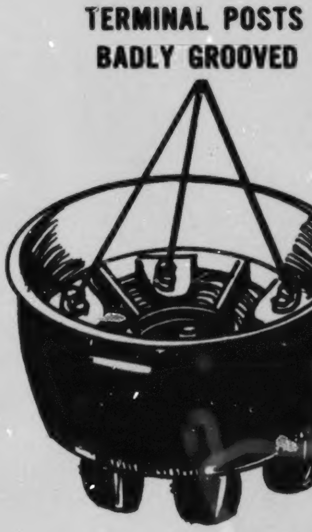

OHMMETER
PLUG WIRE
CHECKING RESISTANCE

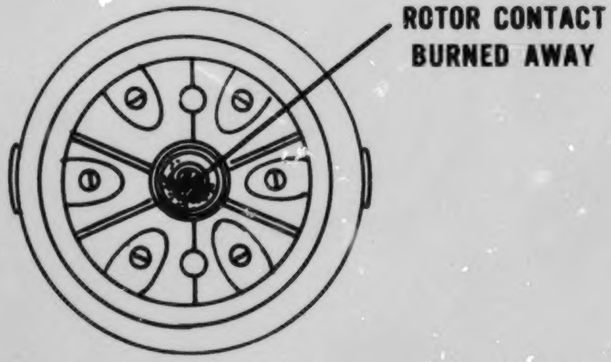
SPARK PLUG WIRES

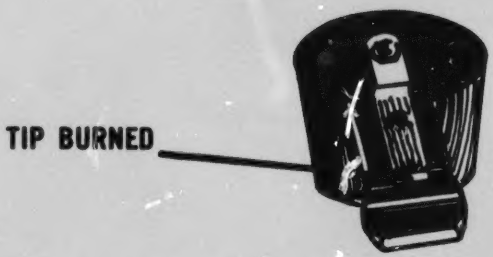

COIL CONNECTOR CLIP
BOOTS
PLUG CONNECTOR CLIPS
PLUG WIRES

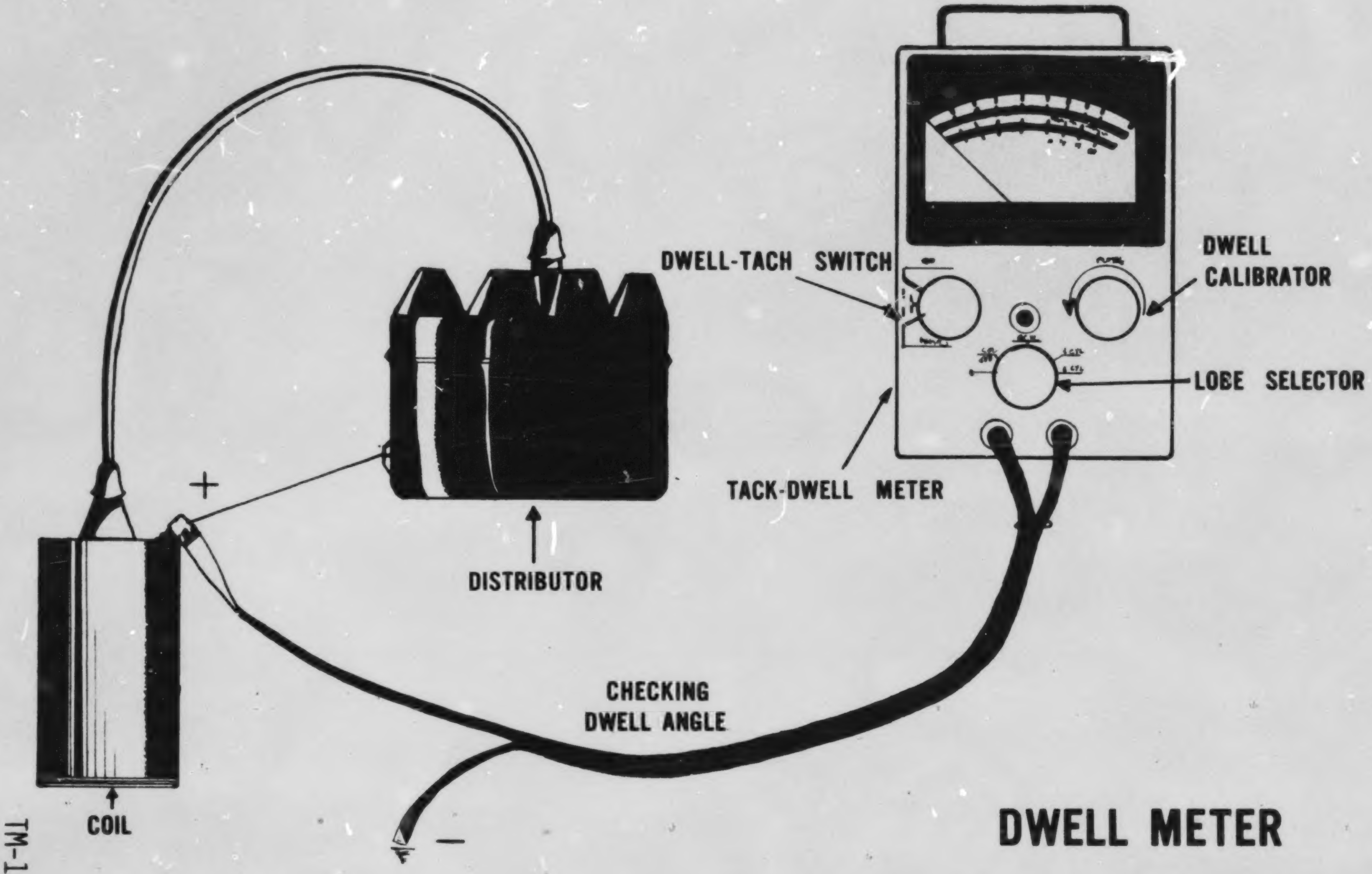
DISTRIBUTOR CAP
(Check Points)


CARBON TRACKING


TERMINAL POSTS
BADLY GROOVED


ROTOR CONTACT
BURNED AWAY




DWELL-TACH SWITCH
DWELL CALIBRATOR
LOBE SELECTOR
TACK-DWELL METER
+
DISTRIBUTOR
CHECKING DWELL ANGLE
COIL
−

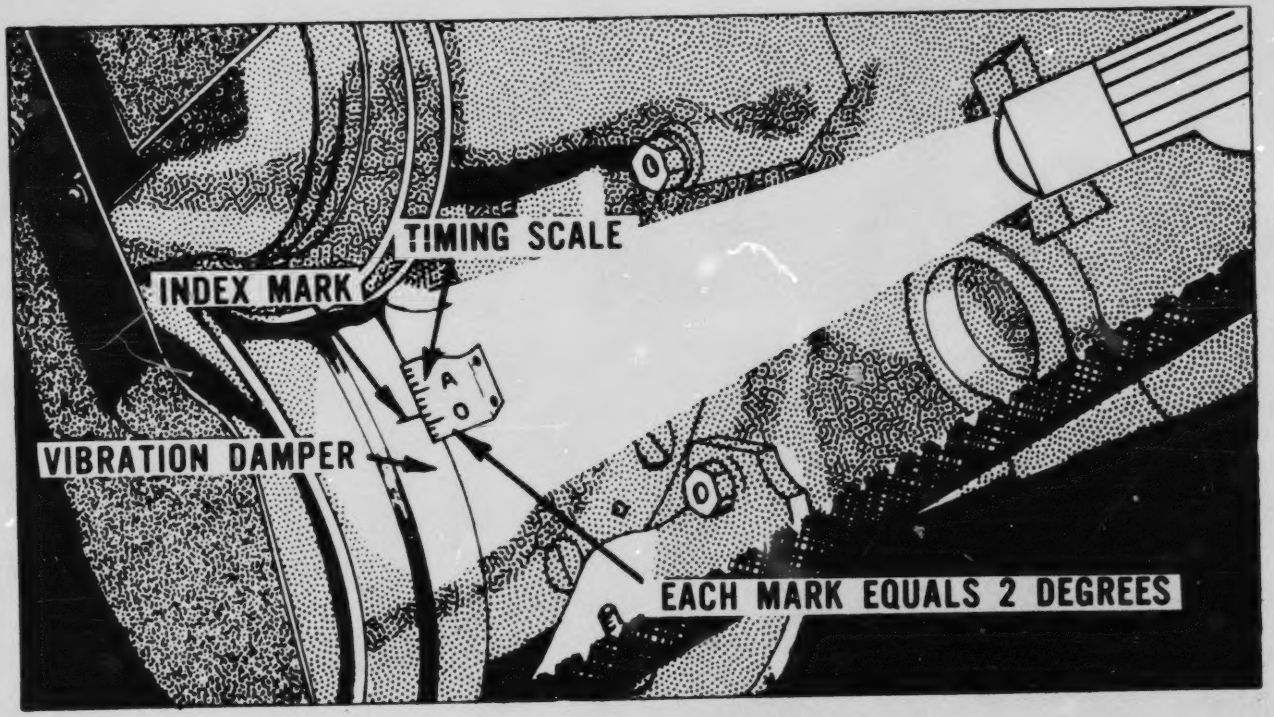
DWELL METER

TM-10

VI-29

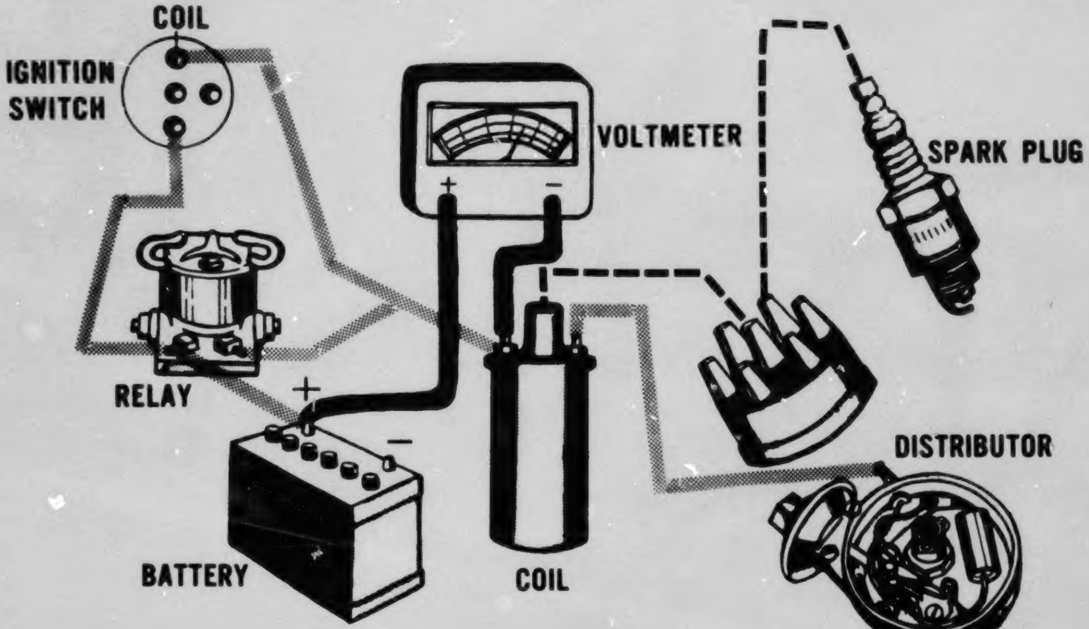
6

TIMING

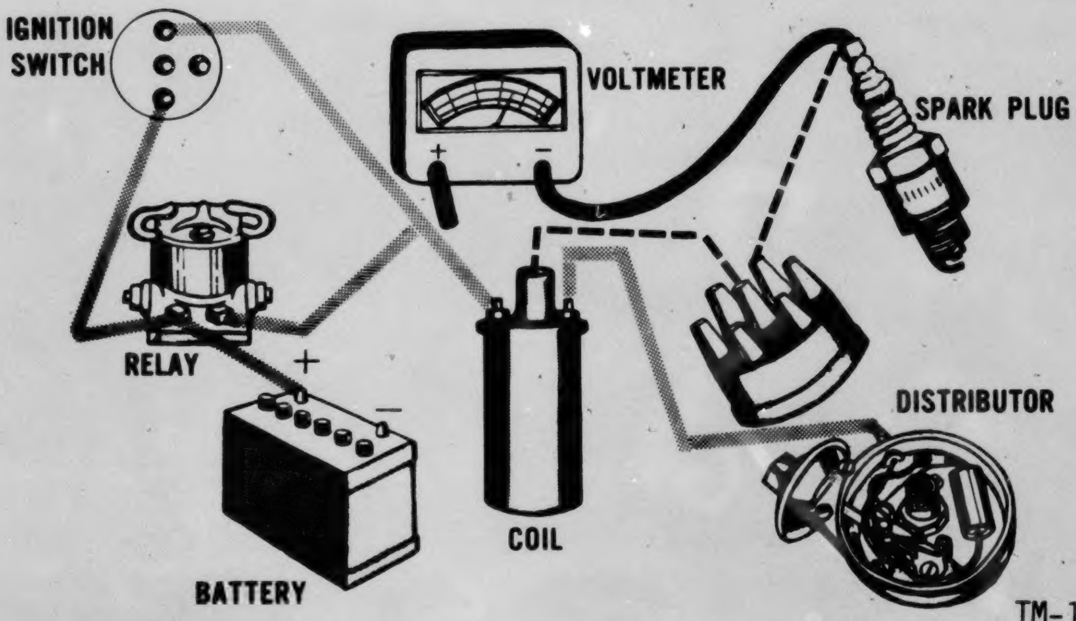

TIMING SCALE
INDEX MARK
VIBRATION DAMPER
EACH MARK EQUALS 2 DEGREES

VOLTMETER

Primary Voltage Test


COIL
IGNITION SWITCH
VOLTMETER
+
−
SPARK PLUG
RELAY
+
−
DISTRIBUTOR
BATTERY
COIL

Secondary Voltage Test


IGNITION SWITCH
VOLTMETER
+
−
SPARK PLUG
RELAY
+
−
DISTRIBUTOR
COIL
BATTERY

TM-12

UNIT VI

IGNITION SYSTEM

JOB SHEET #1--CHANGE SPARK PLUGS

I. Tools and materials required

- A. Proper size socket
- B. Ratchet drive
- C. Extension (length required)
- D. Thickness gauge
- E. Torque wrench
- F. Auto manual
- G. Fender cover
- H. New spark plugs

II. Procedure

(Note: Follow all safety rules.)

- A. Install fender cover.
- B. Wearing goggles, blow any dirt from the base of each plug with compressed air.
- C. Remove wire from plug on one side of the engine.
- D. Remove spark plugs, keeping them in order of removal, so that any unusual plug condition may be related to a cylinder problem.
- E. As each plug is removed, examine for cylinder conditions such as fuel fouling, oil fouling, shell fouling, and overheating.
- F. Check auto manual to be sure the number on the new plugs is the right one for that specific engine.
- G. Check the gap on the new plugs and set according to engine type, as specified in the auto manual.
- H. Install new plugs in engine.
- I. Torque the plugs to correct amount.

J. Install spark plug wires to same engine spark plugs as removed.

(Note: Completing one plug change at a time will prevent crosswiring.)

UNIT VI

IGNITION SYSTEM

JOB SHEET #2--CHANGE BREAKER POINTS AND CONDENSER

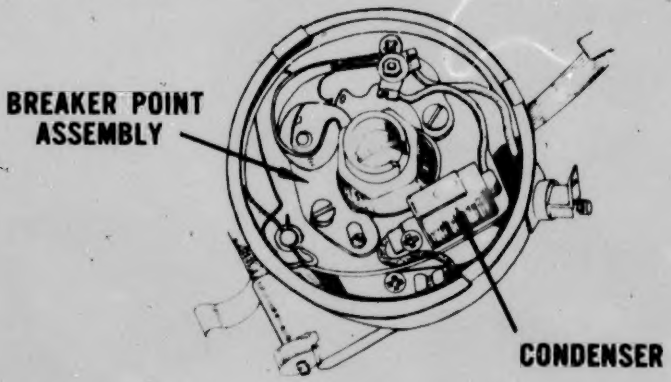
I. Tools and materials required

- A. Common screwdriver
- B. Thickness gauge
- C. Fender cover
- D. Dwell meter
- E. Allen wrench set
- F. New breaker points and condenser
- G. Auto manual

II. Procedure

(Note: Follow all safety rules.)

- A. Install fender cover.
- B. Remove distributor cap.
- C. Loosen and remove screws holding breaker points and breaker point assembly.



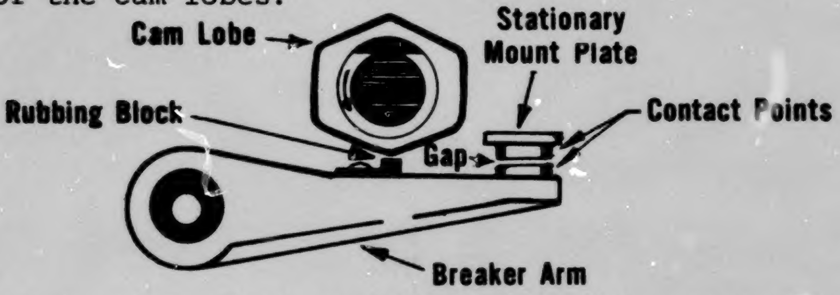
- D. Remove the condenser

(Note: The condenser should be replaced when replacing breaker points.)

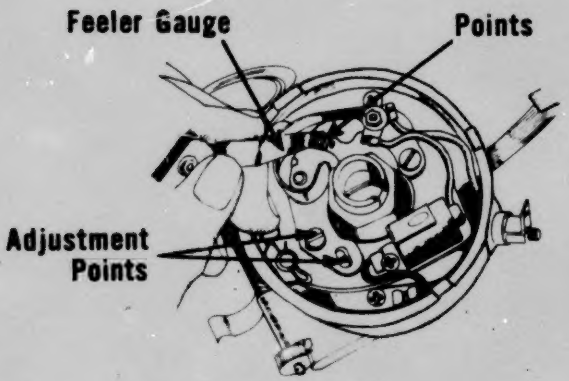
E. Install new breaker points and condenser.

(Note: Be sure points are properly aligned.)

F. Set breaker points rubbing block on highest tip of the cam lobes.


Cam Lobe
Stationary Mount Plate
Rubbing Block
Contact Points
Gap
Breaker Arm

G. Set breaker points to the correct gap, using the thickness gauge dwell meter, according to the auto manual or engine decal.


Feeler Gauge
Points
Adjustment Points

H. Install the distributor cap.

I. Put car in neutral and set parking brake.

J. Start car and let the engine run.

K. If engine runs properly, turn off engine, turn in tools, and clean work area.

L. If engine is not running properly, ask your instructor for assistance.

UNIT VI

IGNITION SYSTEM

JOB SHEET #3--CHANGE SPARK PLUG WIRES

I. Tools and materials required

  A. Fender cover

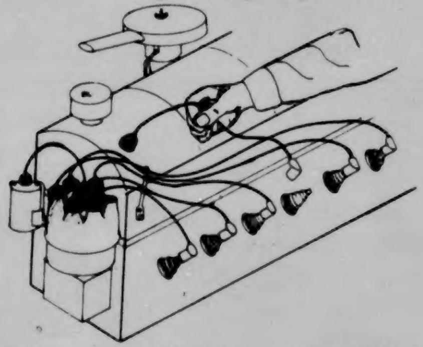
  B. New plug wires

II. Procedure

  (Note: Follow all safety rules.)

  A. Install fender cover.

  B. Remove one spark plug wire from the engine.



  C. Replace it with a new one.

  D. Replace each additional spark plug wire until all are replaced.

  E. Place new boots on wires, if not already in place.

  F. Make sure each wire is snapped firmly on the plug and is fully seated in the distributor tower.

  G. Put car in neutral and set parking brake.

  H. Start engine and allow to run.

  I. In a darkened room, check engine for flashover.

UNIT VI

IGNITION SYSTEM

JOB SHEET #4--INSPECT DISTRIBUTOR CAP

I. Tools and materials required

  A. Fender cover

  B. Common screwdriver

II. Procedure

  (Note: Follow all safety rules.)

  A. Install fender cover.

  B. Remove distributor cap.

    (Note: Remove with screwdriver, if necessary.)

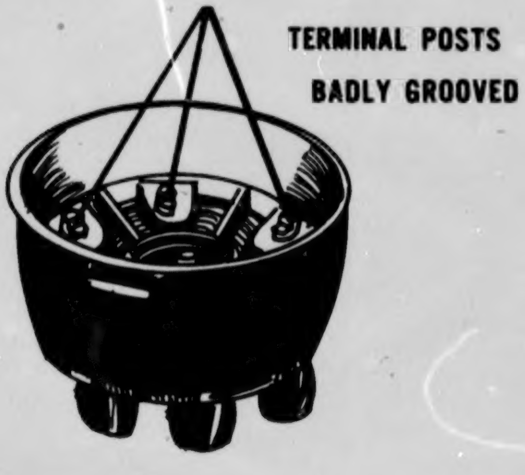
  C. Check the cap, looking for moisture, burning, cracks, or flashover.

  D. If wires need changing, remove only one wire at a time and transfer it to the new cap.

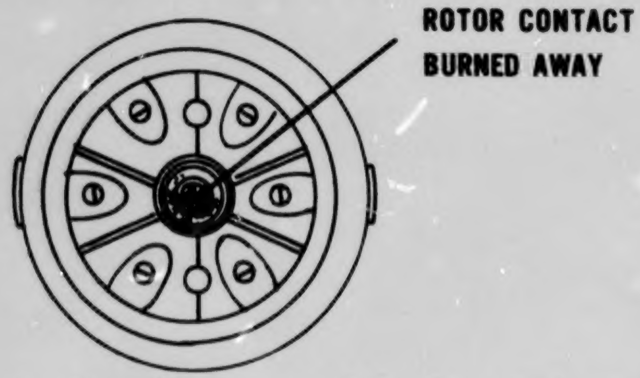
  E. Replace the distributor cap if flashover has been present.

  F. Replace the rotor when replacing the distributor cap.

  G. Check the terminal post for burning or scaling.



H. Check the central carbon button contact for burning or cracking.



I. If the distributor cap does not need replacing, clean the original cap in warm water and mild detergent.

J. Dry the cap thoroughly.

K. Replace the distributor cap.

L. Clean work station and turn in tools.

UNIT VI

IGNITION SYSTEM

JOB SHEET #5--USE THE DWELL METER

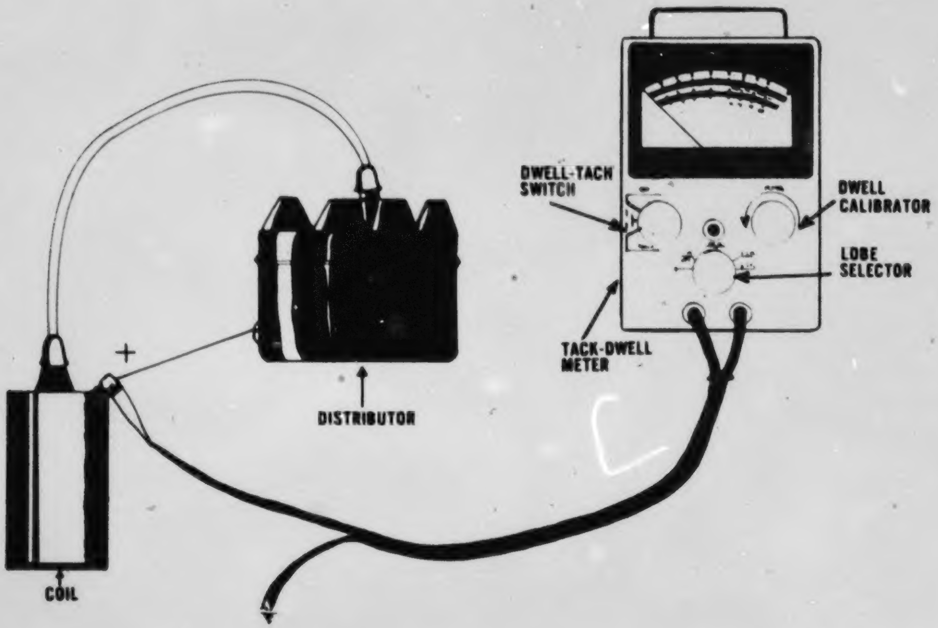
I. Tools required

- A. Dwell meter
- B. Common screwdriver
- C. Allen wrench set
- D. Fender cover
- E. Auto manual

II. Procedure

(Note: Follow all safety rules.)

- A. Install fender cover.
- B. Turn on dwell meter and calibrator needle.
- C. Attach the dwell meter with the red lead to the positive post on the coil and the black lead to any ground.


DWELL-TACH SWITCH
DWELL CALIBRATOR
LOBE SELECTOR
TACK-DWELL METER
+
DISTRIBUTOR
COIL

D. Set the dwell meter pointer to the correct dwell as described in the auto manual.

E. Place automobile in neutral or park and set the parking brake.

F. Start engine and run at a fast idle, or about 1500 RPM, while checking the dwell angle.

G. Adjust the breaker points as necessary to reach the desired dwell angle.

H. Turn off engine.

I. Clean work area and turn in tools.

UNIT VI

IGNITION SYSTEM

JOB SHEET #6--USE THE TIMING LIGHT

I. Tools and materials required

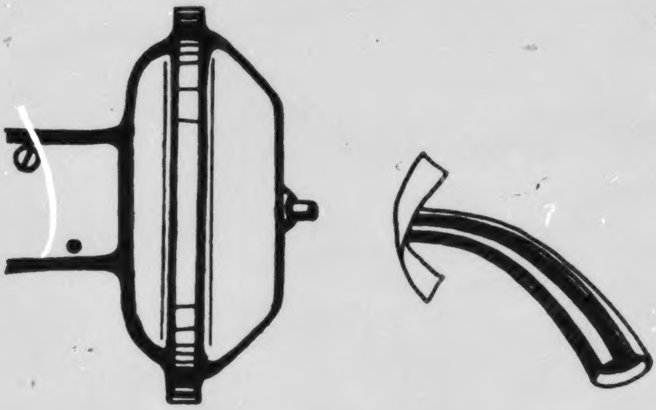
- A. Timing light
- B. Chalk
- C. 9/16" x 1/2" box-end wrench
- D. Fender cover

II. Procedure

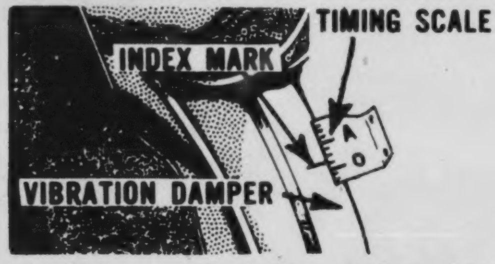
(Note: Follow all safety rules.)

A. Attach the timing light to the engine with the red lead to the positive post on battery, the black lead to the negative post on battery, and the large wire to the #1 engine spark plug wire.

B. Remove the vacuum advance hose and tape the vacuum fitting if recommended in auto manual.



C. Clean off the timing pointer or scale and also the index mark on the vibration damper.


TIMING SCALE
INDEX MARK
A
O
VIBRATION DAMPER

D. Chalk or paint the index line to make it easier to read.

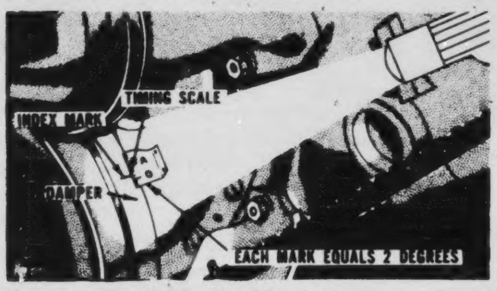
E. Place automobile in neutral or park and set the parking brake.

F. Start the engine and idle at recommended RPM.

(Note: The engine should be at a slow idle.)

G. Direct the timing light beam on the timing marks.

H. Loosen the distributor clamp.


TIMING SCALE
INDEX MARK
A
DAMPER
EACH MARK EQUALS 2 DEGREES

I. Turn the distributor as required to bring the mark in line with the pointer as specified in the auto manual.

J. Tighten the distributor clamp and recheck the marks to see if they are still aligned.

(Note: Point gap or dwell must be set before timing the engine as changing the gap will alter the timing.)

K. Turn off engine.

L. Clean work area and turn in tools.

UNIT VI

IGNITION SYSTEM

JOB SHEET #7--USE THE VOLTMETER

I. Tools and materials required

   A. Voltmeter

   B. Fender cover

II. Procedure

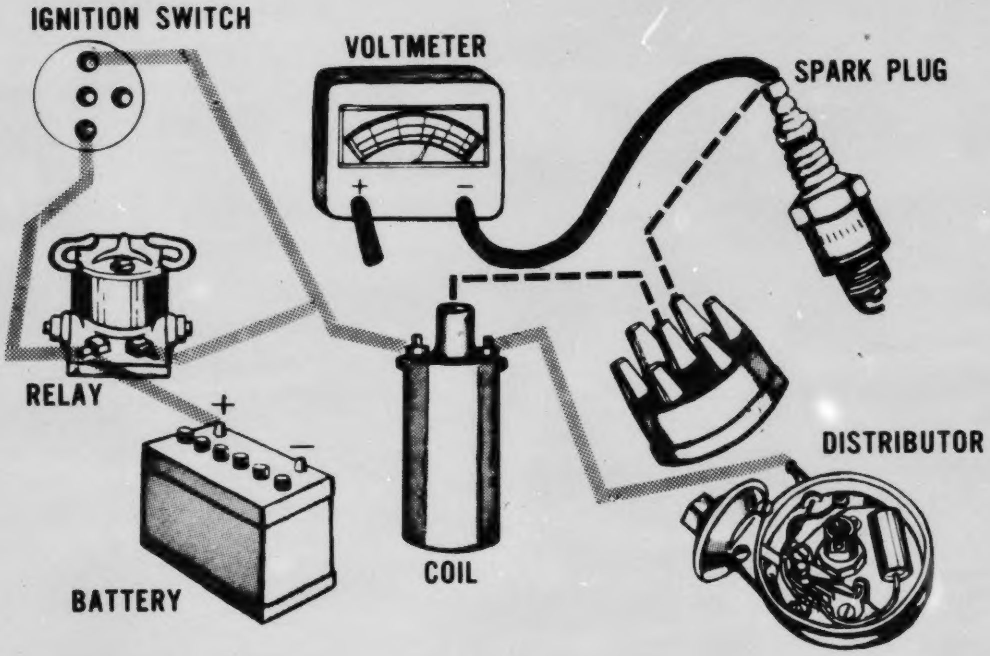
   (Note: Follow all safety rules.)

   A. Set the voltmeter scale to a voltage scale that is higher than the voltage expected.

   (Example: If you are expecting a voltage reading of 12 volts, set the meter on the 25-volt scale.)

   B. To read any voltage, attach the meter with the red lead attached to a power or hot wire and the black lead to a ground.

   Example:


IGNITION SWITCH
VOLTMETER
SPARK PLUG
+
−
RELAY
+
−
DISTRIBUTOR
COIL
BATTERY

C. Set the meter on DC to check automotive DC current.

D. Check the auto manual for possible voltage checks and voltage specifications.

E. After necessary voltage checks have been made, set the current selector on AC and the voltage selector on the highest voltage scale before storing the meter.

F. Turn in tools.

UNIT VI

IGNITION SYSTEM

UNIT TEST

1. Explain the purpose of the ignition system.

2. Match the term to the correct definition associated with the ignition system.

____a. A storage place for electricity where chemical energy is converted into electrical energy

____b. The path through which electricity flows

____c. Current as supplied by batteries that flows in one direction only

____d. A unit located in a wire or circuit to prevent an overload in the electrical system before the wire burns up

____e. The connection of an electrical unit to the engine or frame to return current to its source

____f. A term used for high voltage

____g. Process of setting fire to a fuel in combustion chamber by means of a spark

____h. Body of metal that has the ability to attract

____i. The measure of resistance to the flow of electricity

____j. The fuel-air mixture ignites or burns before it should

____k. A magnetically operated switch used to make and break the flow of current in a circuit

1. Relay
2. Ohm
3. Resistor
4. Battery
5. Fuse
6. Short circuit
7. Magnet
8. Circuit
9. High Tension
10. Pre-igniting
11. DC circuit
12. Ignition
13. Ground

____l. A hot wire in the electrical system that has become grounded

____m. A device placed in a circuit to lower voltage

3. Match the term with the correct description of each component of the ignition system.

____a. A storage place for electricity where chemical energy is converted into chemical energy

____b. A switch in the cranking device of an engine

____c. The device used for opening and closing all electrical circuits on an automobile

____d. A resistor made of a wire which will increase or decrease voltage as the heat of the wire changes

____e. A unit used to set up battery voltage to a point necessary to fire a spark plug

____f. A unit designed to make and break the main ignition circuit and to distribute resulting high voltage to the proper cylinder at the right time

____g. A device with two electrodes which provides an air gap for a spark to jump across and ignite fuel-air mixture in the combustion chamber

1. Coil
2. Battery
3. Spark plug
4. Ignition switch
5. Starter relay
6. Distributor
7. Ballast resistor

4. Match the correct term with each of the component parts of the distributor by placing the number of the part in the blank.

____a. Distributor cap

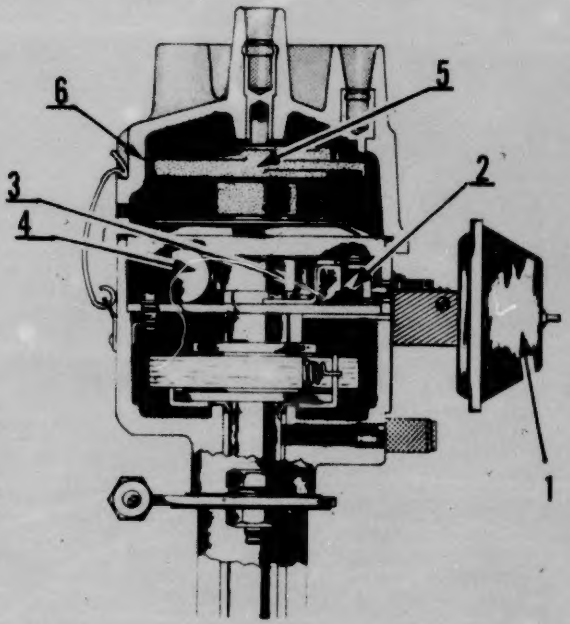
____b. Rotor

____c. Cam

____d. Vacuum advance

____e. Breaker points

____f. Condenser



5. Identify the fouling conditions of plugs by placing the correct number in the blanks.

____a. Plug has deposits of black dry carbon which are caused from the plugs being too cold, a high level of fuel in the carburetor, excessive choking, or a clogged air cleaner

____b. Plugs are covered with wet, black deposits caused by an excessive amount of oil reaching the combustion chamber

____c. New plugs coated with splashes of carbon deposits because th plugs were installed in an engine that had heavy depos of carbon in the combustion chamber

____d. A plug fouled with particles of molten aluminum, caused by the piston breaking up due to rapid

1. Gap bridging
2. Aluminum throw-off
3. Shell bridging
4. Oil fouling
5. Fuel fouling
6. Splashed fouling
7. High-speed glazing

combustion, pre-ignition, or over-advanced ignition timing

____e. A plug with a large piece of piston or combustion chamber deposit sticking between the hot insulator and plug shell

____f. A plug with carbon-lead deposits connecting the two electrodes

____g. A plug with a hard, shiny, yellowish-tan deposit, caused by a sudden increase in plug temperatures during hard acceleration or loading

6. Match the correct testing equipment with the function of each by placing the number in the blanks.

____a. A device for checking the gap on spark plug or points, measuring in thousandths

____b. A testing instrument that measures the number of degrees the distributor cam rotates from the time the points open until they close

____c. A unit that is connected to the engine ignition system and which produces flashes of light in time with the firing of the No. 1 spark plug

____d. An instrument used to measure volts in any circuit

1. Timing light
2. Dwell meter
3. Voltmeter
4. Thickness gauge

7. Demonstrate the ability to:

a. Change spark plugs.

b. Change breaker points and condenser.

c. Change spark plug wires.

d. Inspect distributor cap.

e. Use dwell meter.

f. Use timing light.

g. Use voltmeter.

(Note: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT VI

IGNITION SYSTEM

ANSWERS TO TEST

1. The purpose of the ignition system is to supply and distribute high-voltage sparks that ignite the fuel-air mixture within the combustion chamber.

2. ___4___ a.
___8___ b.
___11___ c.
___5___ d.
___13___ e.
___9___ f.
___12___ g.
___7___ h.
___2___ i.
___10___ j.
___1___ k.
___6___ l.
___3___ m.

3. ___2___ a.
___5___ b.
___4___ c.
___7___ d.
___1___ e.
___6___ f.
___3___ g.

4. ___6___ a.
___5___ b.
___3___ c.
___1___ d.
___2___ e.
___4___ f.

5. ___5___ a.
___4___ b.
___6___ c.
___2___ d.
___3___ e.
___1___ f.
___7___ g.

6. ___4___ a.
___2___ b.
___1___ c.
___3___ d.

7. Evaluated to the satisfaction of the instructor

UNIT VII

LUBRICATION SYSTEM

UNIT OBJECTIVE

After completion of this unit, the student will be able to properly inspect and service the lubrication system. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the lubrication system
2. Match the terms associated with the lubrication system to the correct definition
3. Point out the five functions of oil
4. Select the proper type of oil filter
5. Pick out the types of lubrication systems
6. Point out the factors that cause lubricants to break down
7. Choose the correct type of lubricant used on each of the vehicle areas
8. Demonstrate the ability to:
    a. Check engine oil level
    b. Change engine oil
    c. Change engine oil filter
    d. Check automatic transmission fluid level
    e. Check automatic transmission fluid
    f. Check standard transmission oil level
    g. Check differential oil level
    h. Check manual steering gear oil
    i. Check power steering pump level
    j. Lubricate chassis

UNIT VII

LUBRICATION SYSTEM

SUGGESTED ACTIVITIES

I. Instructor

  A. Provide students with objective sheet

  B. Provide students with information and job sheets

  C. Make transparencies

  D. Discuss unit and specific objectives

  E. Discuss information and job sheets

  F. Demonstrate the procedures outlined on the job sheets

  G. Give test

II. Students

  A. Read objectives

  B. Study information sheet

  C. Perform the jobs outlined on the job sheets

  D. Take test

INSTRUCTIONAL MATERIALS

I. Included in this unit

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM-1--Checking the Engine Oil Level

    2. TM-2--Changing the Engine Oil

    3. TM-3--Changing the Engine Oil Filter

    4. TM-4--Checking the Oil Level of an Automatic Transmission

5. TM-5--Checking the Oil Level of a Standard Transmission

6. TM-6--Checking the Oil Level of the Differential

7. TM-7--Checking the Oil Level in a Power Steering Pump

8. TM-8--The Engine Lubrication System

9. TM-9--Lubricating the Chassis

D. Job sheets

1. Job Sheet #1--Check Engine Oil Level

2. Job Sheet #2--Change Engine Oil

3. Job Sheet #3--Change Engine Oil Filter

4. Job Sheet #4--Check Automatic Transmission Fluid Level

5. Job Sheet #5--Change Automatic Transmission Fluid

6. Job Sheet #6--Check Standard Transmission Oil Level

7. Job Sheet #7--Check Differential Oil Level

8. Job Sheet #8--Check Manual Steering Gear Oil Level

9. Job Sheet #9--Check Power Steering Pump Oil Level

10. Job Sheet #10--Lubricate Chassis

E. Test

F. Answers to test

II. References:

Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1975.

UNIT VII

LUBRICATION SYSTEM

INFORMATION SHEET

I. The purpose of the lubrication system is to reduce friction throughout the automobile by means of oil or grease, making the automobile a more economical, longer-lasting vehicle.

II. Terms and definitions

- A. Friction--Resistance to any motion between two surfaces in contact
- B. Oil--A by-product made from petroleum used for lubrication
- C. Oil seal--A device used to prevent oil leakage past a certain point of the engine
- D. Oil filter--A part of the lubrication system used to clean the oil
- E. Oil pump--A device used to force oil through the engine
- F. Oil bath air cleaner--Unit using oil to clean air entering the engine
- G. Lubricant--Any material used to prevent friction between two surfaces
- H. Differential--A unit that drives both rear axles, but will allow them to turn at different speeds when making turns
- I. Additive--A material or solution added to a mixture to increase efficiency
- J. Dipstick--A metal stick used to measure the oil level in an engine or automatic transmission
- K. S.A.E.--Society of Automotive Engineers
- L. ML--Motor light oil
- M. MM--Motor medium oil
- N. MS--Motor severe oil

O. Sump--The part of the engine that holds the oil

IV. The five functions of oil

A. Cools

B. Cleans

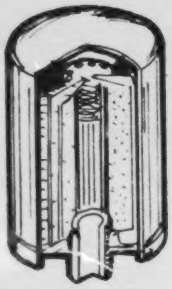
C. Cushions

D. Lubricates

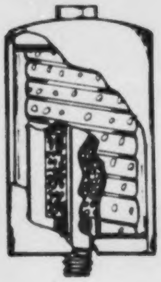
E. Seals

V. Types of oil filters

A. Throw-away type



B. Permanent metal container type with disposable element



VI. Types of lubrication systems

A. Full pressure oiling

B. Splash oiling

C. Combination splash and pressure

VII. Ways lubricants are broken down

  A. Moisture

  B. Freezing

  C. Excessive heat

  D. Dirt

  E. Misuse

VIII. Types of lubricants

  A. Motor oil--Used in the engine

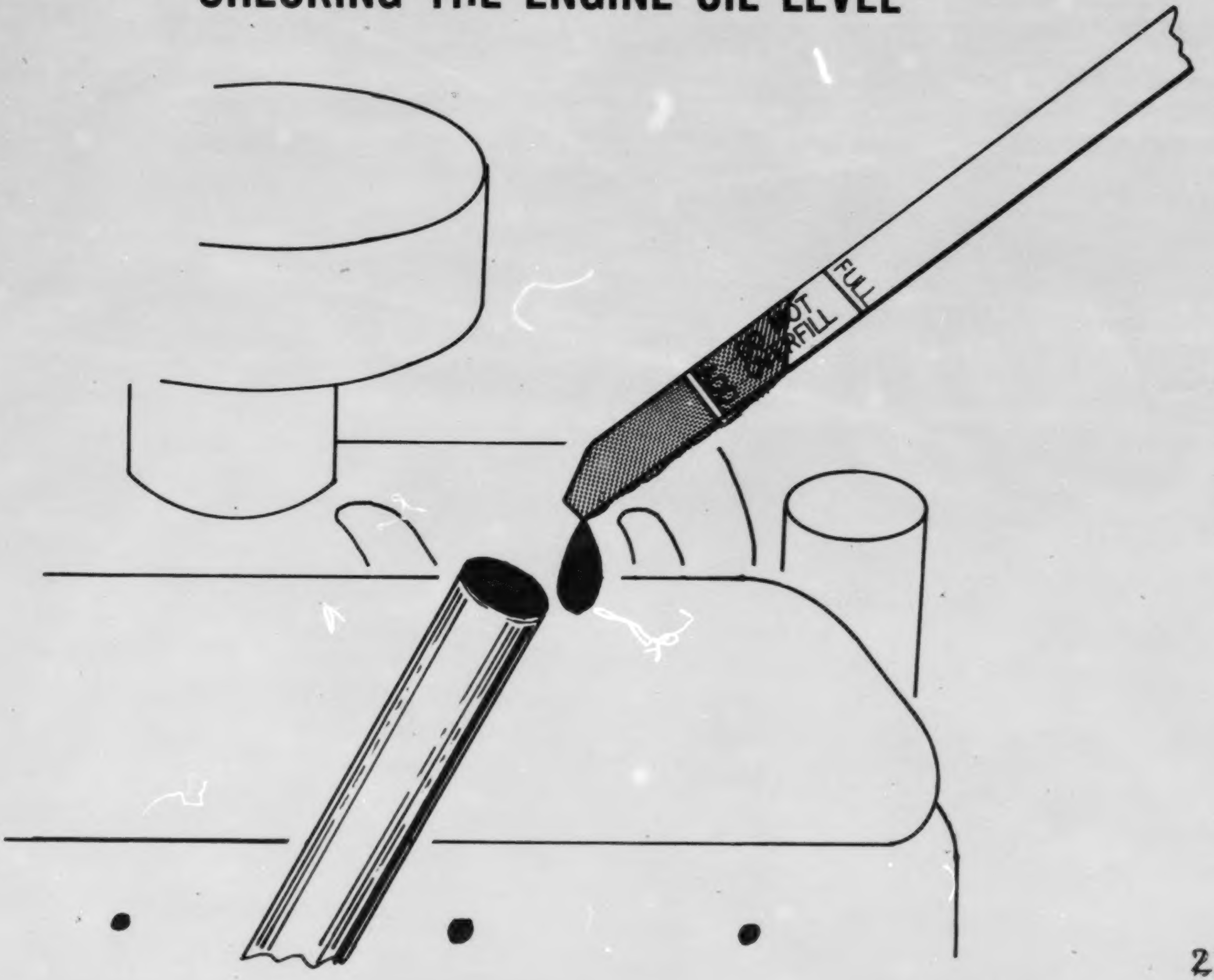
  B. Grease--Used in the transmission

  C. Gear--Used in the transmission

  D. Chassis--Used on rubber mountings

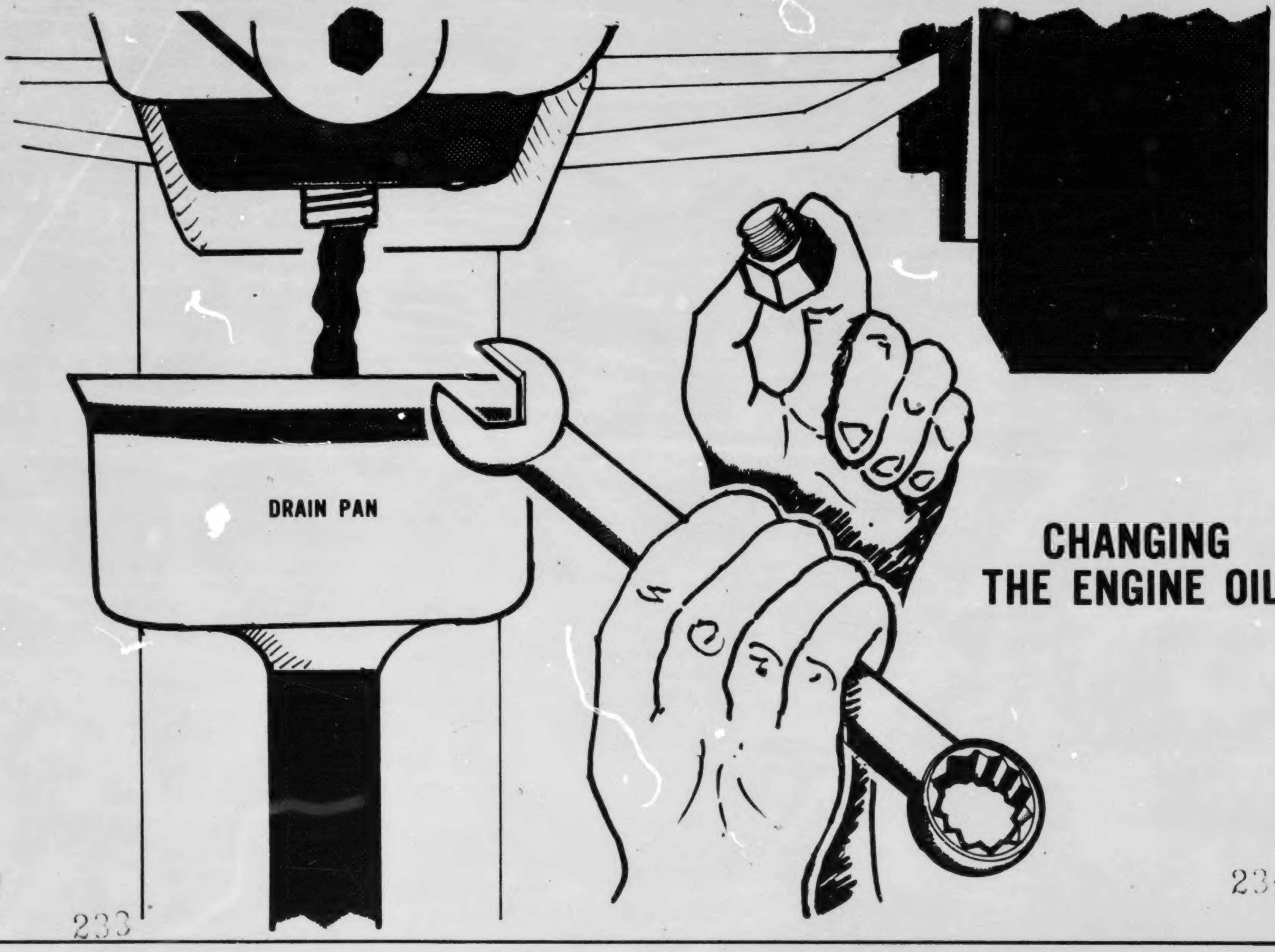
  E. Accessory--For air-conditioning or power steering units

CHECKING THE ENGINE OIL LEVEL


FULL
DO NOT
OVERFILL

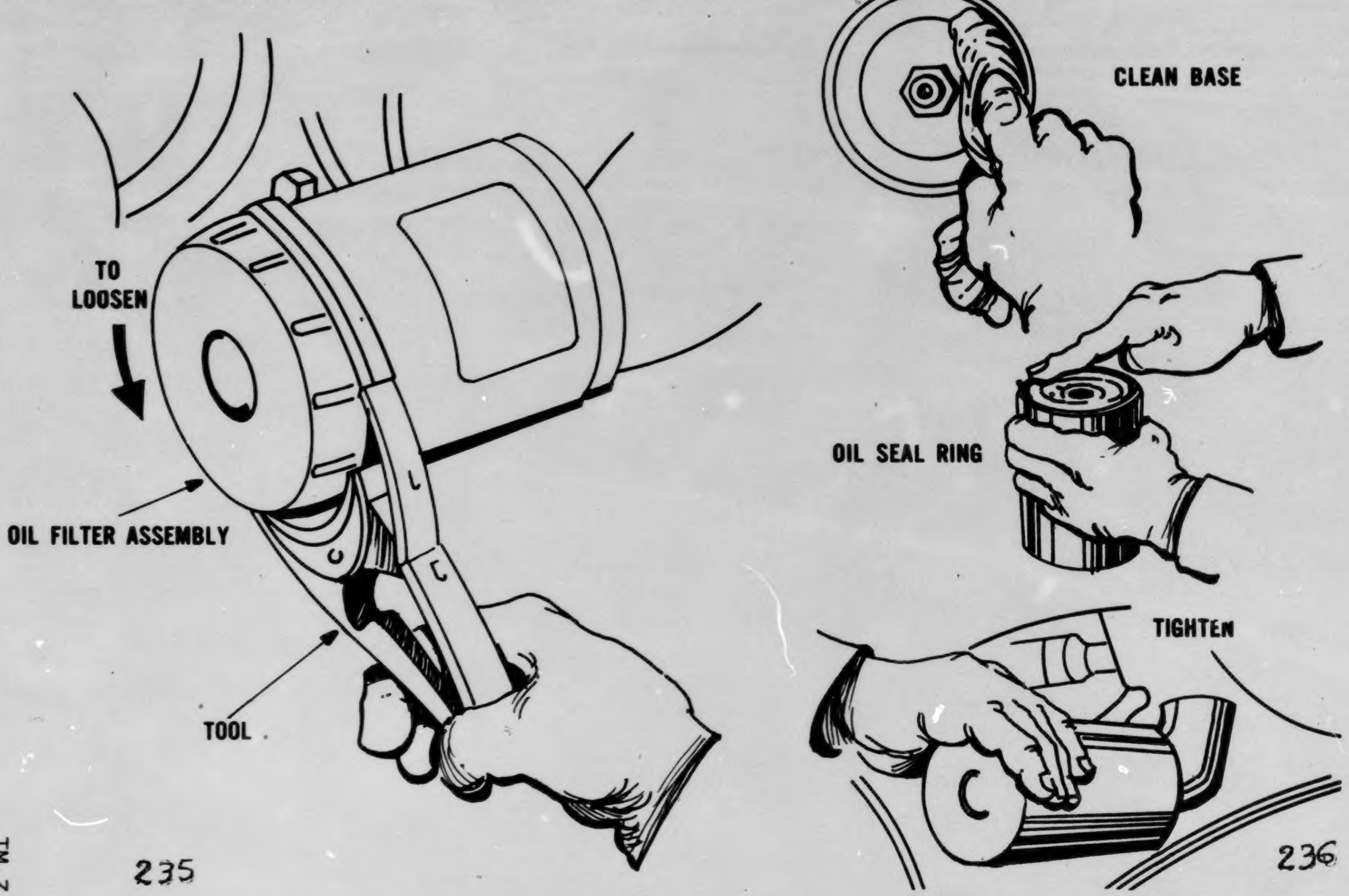
TM-1

VII-9

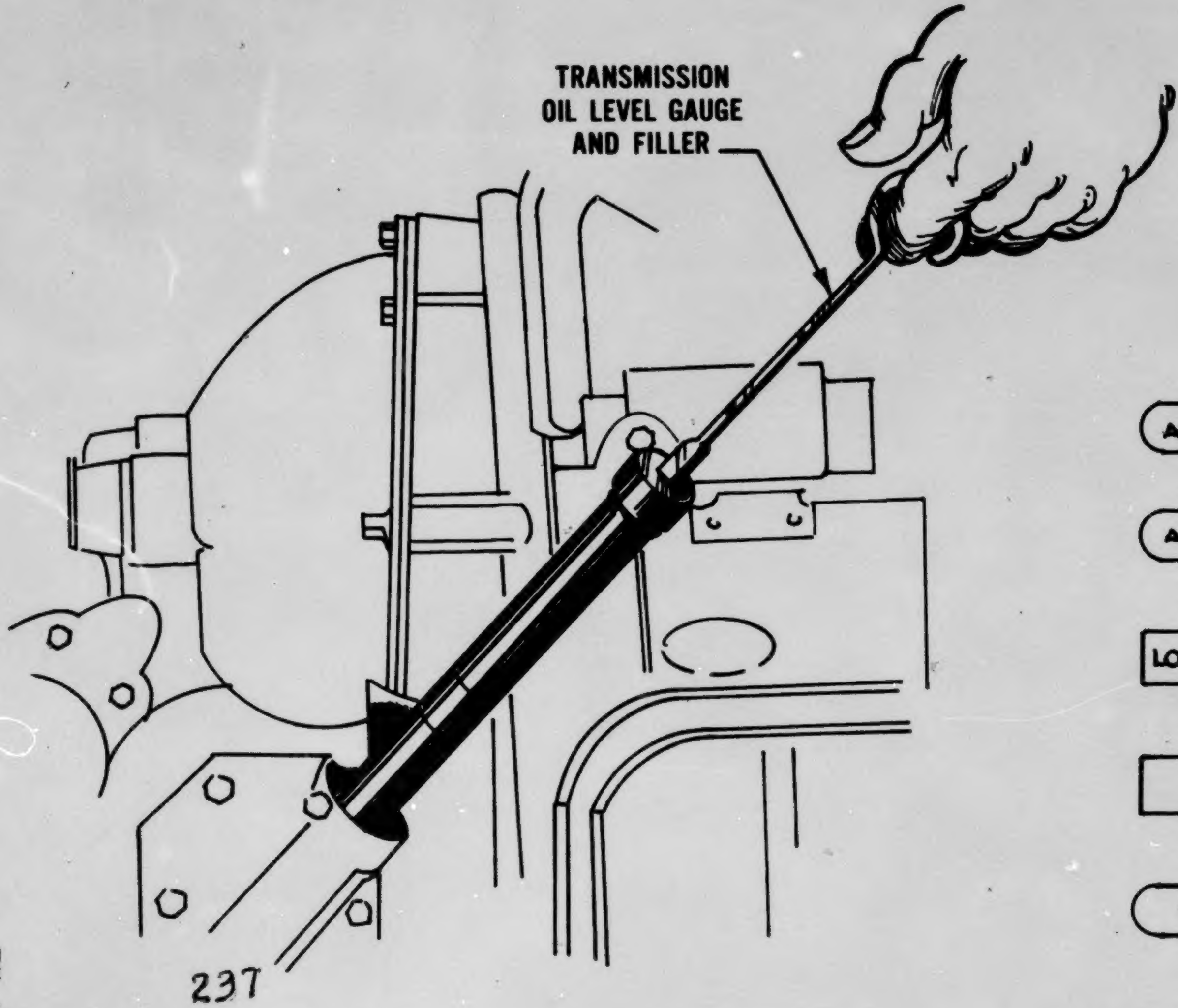


CHANGING THE ENGINE OIL

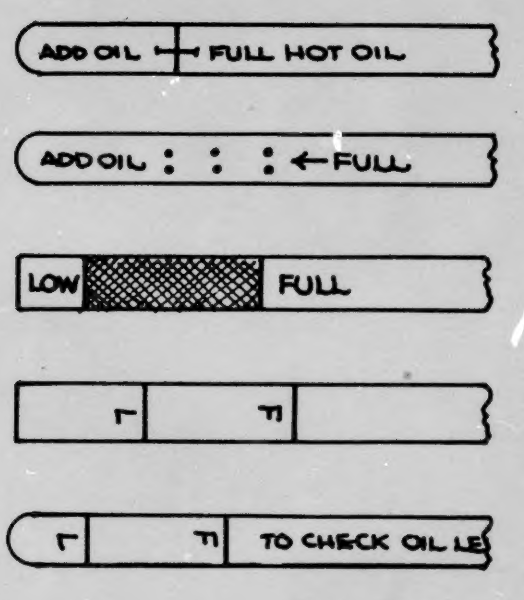
CHANGING THE ENGINE OIL FILTER


TO LOOSEN
OIL FILTER ASSEMBLY
TOOL
CLEAN BASE
OIL SEAL RING
TIGHTEN

CHECKING THE OIL LEVEL OF AN AUTOMATIC TRANSMISSION



TRANSMISSION OIL LEVEL GAUGE AND FILLER



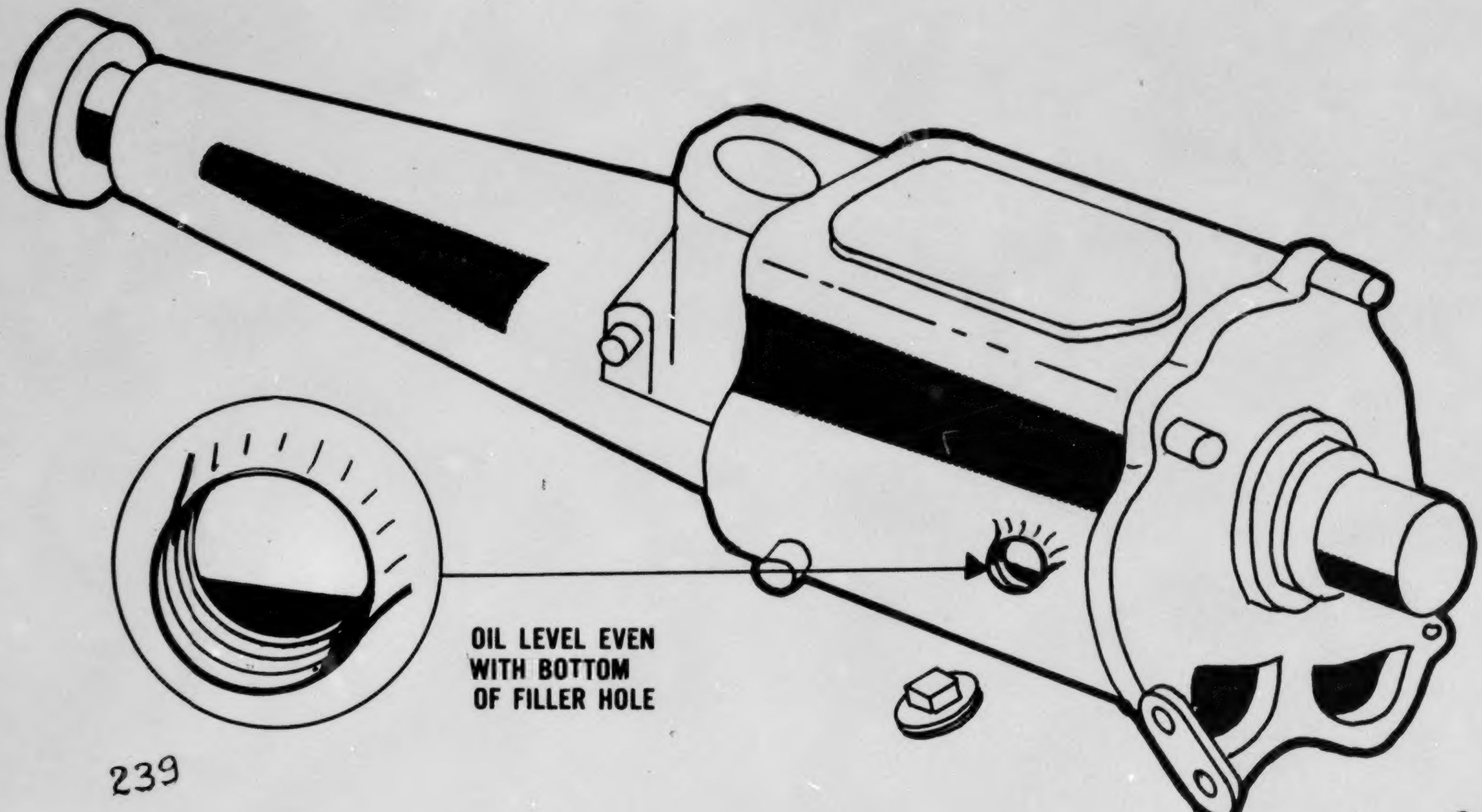
ADD OIL
FULL HOT OIL
ADD OIL
FULL
LOW
FULL
L
F
L
F
TO CHECK OIL LE

TM-4

237

238

CHECKING THE OIL LEVEL IN A STANDARD TRANSMISSION

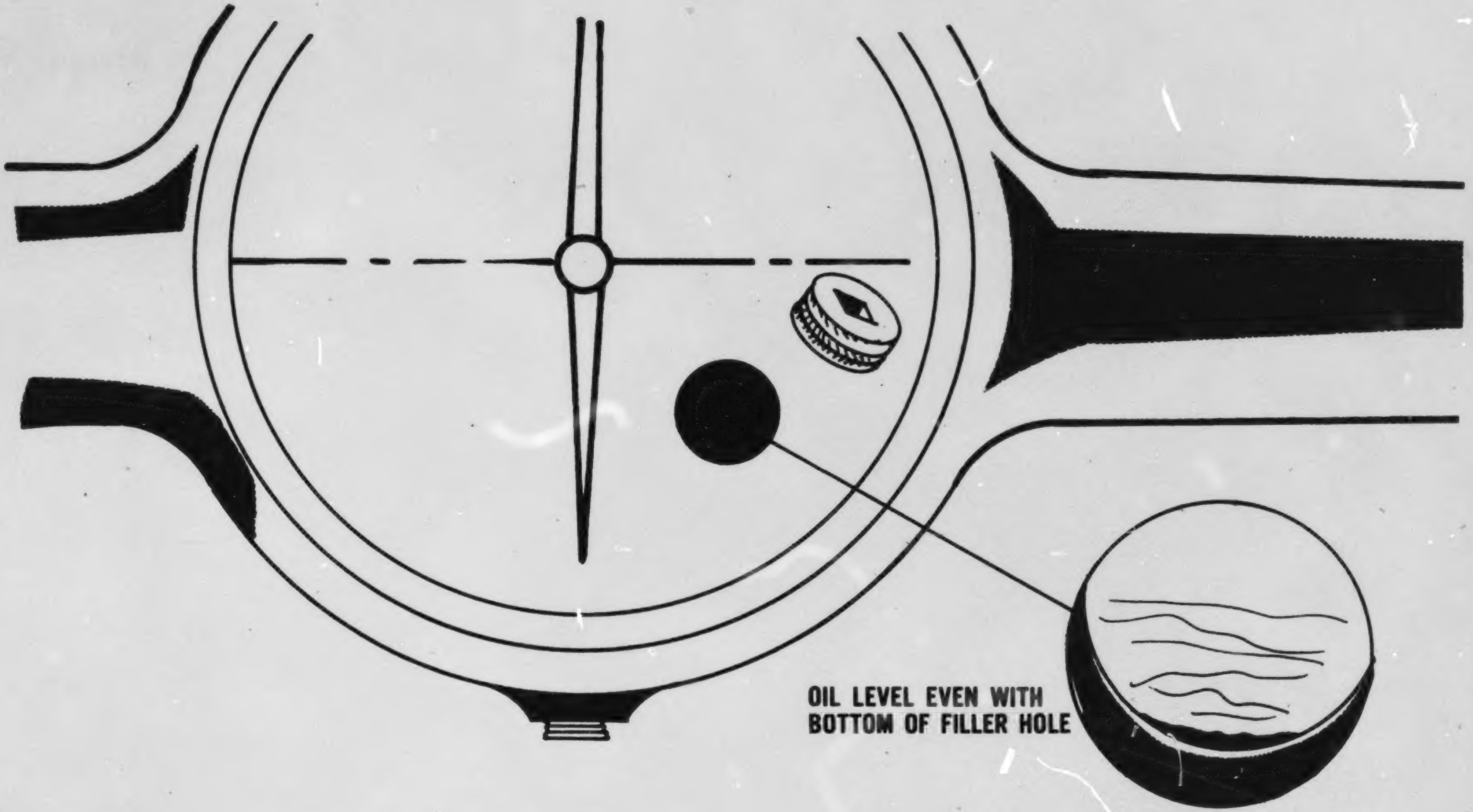


OIL LEVEL EVEN
WITH BOTTOM
OF FILLER HOLE

239

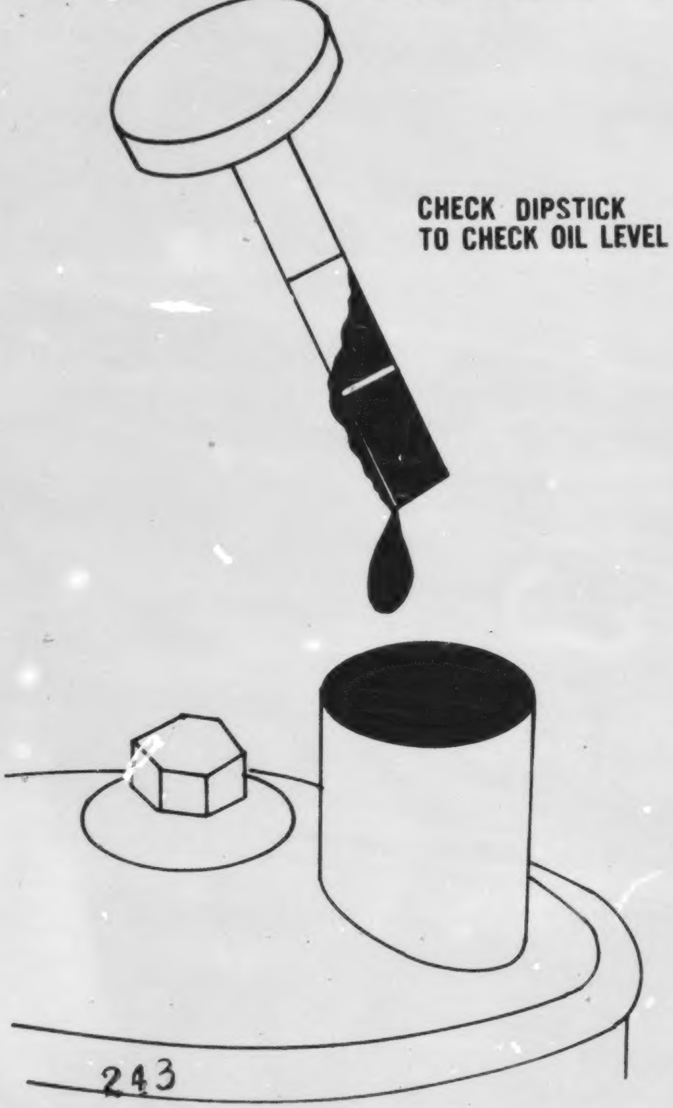
240

CHECKING THE OIL LEVEL OF THE DIFFERENTIAL



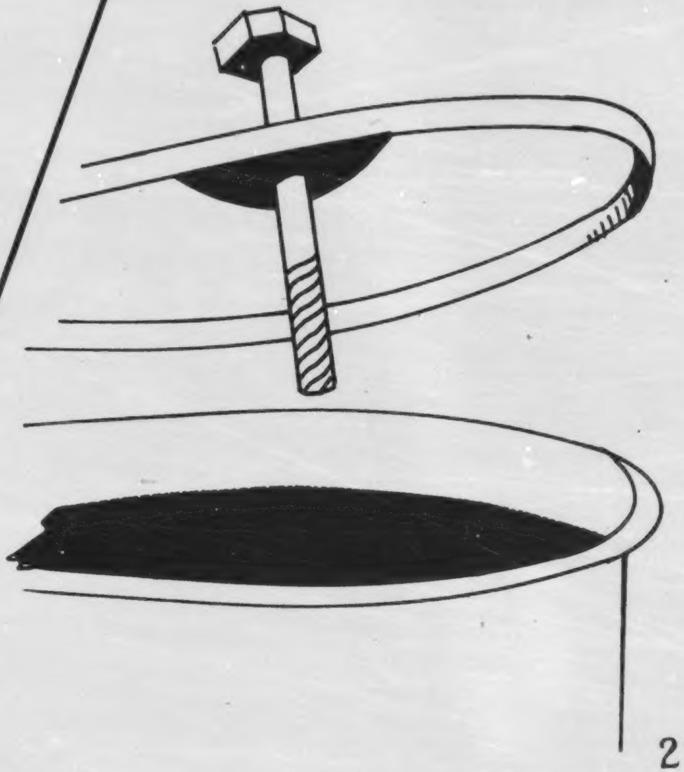
OIL LEVEL EVEN WITH
BOTTOM OF FILLER HOLE

CHECKING THE OIL IN A POWER STEERING PUMP



CHECK DIPSTICK
TO CHECK OIL LEVEL

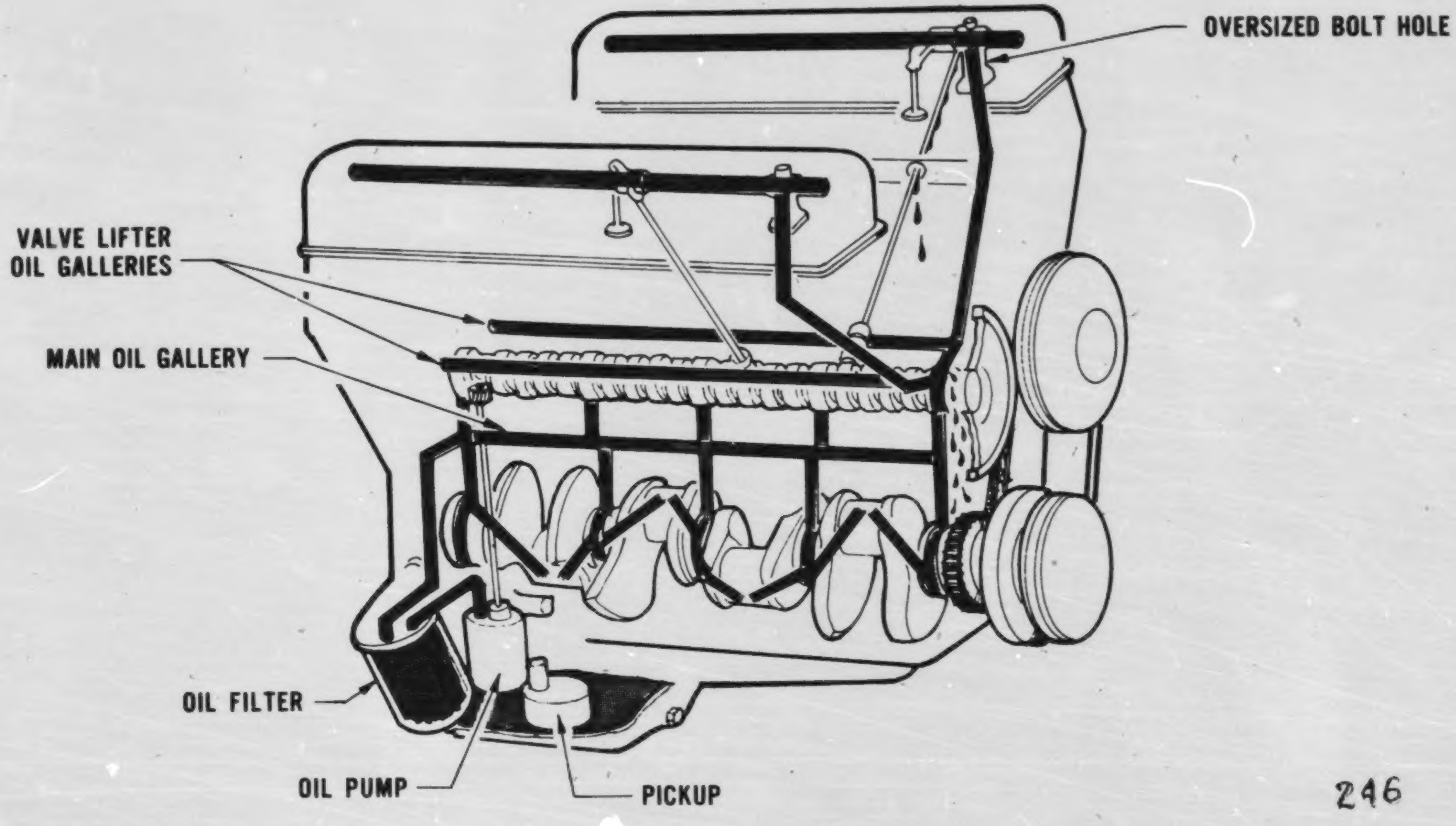
243



REMOVE COVER
TO CHECK OIL LEVEL

244

THE ENGINE LUBRICATION SYSTEM


OVERSIZED BOLT HOLE
VALVE LIFTER OIL GALLERIES
MAIN OIL GALLERY
OIL FILTER
OIL PUMP
PICKUP

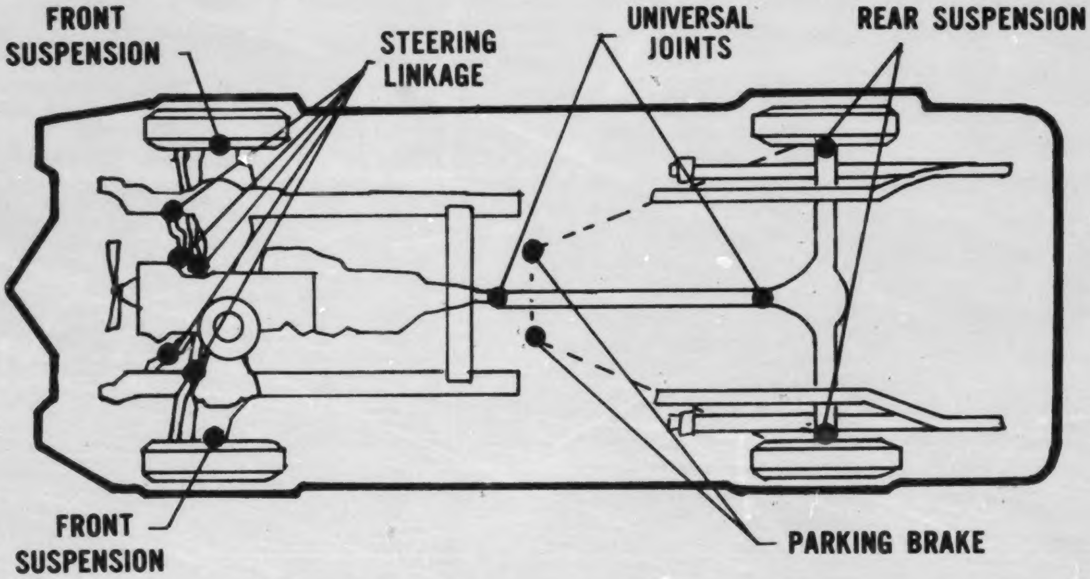
246

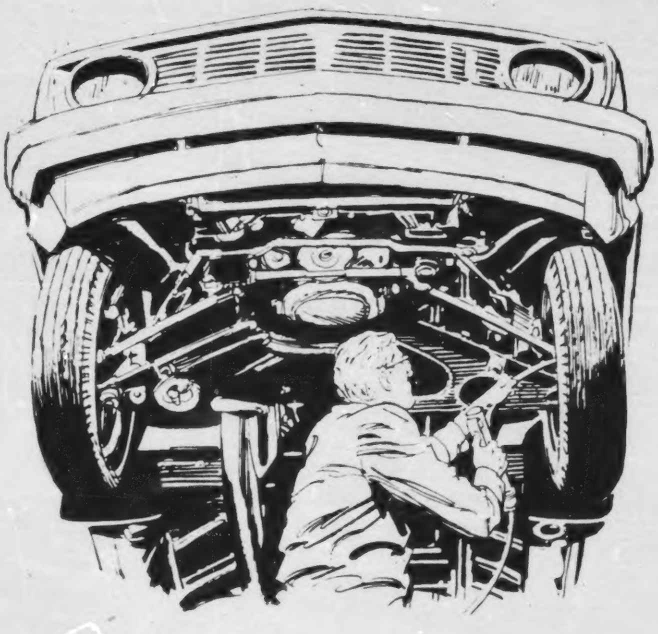
TM-8

245

VII-23

LUBRICATING THE CHASSIS


FRONT SUSPENSION
STEERING LINKAGE
UNIVERSAL JOINTS
REAR SUSPENSION
FRONT SUSPENSION
PARKING BRAKE



UNIT VII

LUBRICATION SYSTEM

JOB SHEET #1--CHECK ENGINE OIL LEVEL

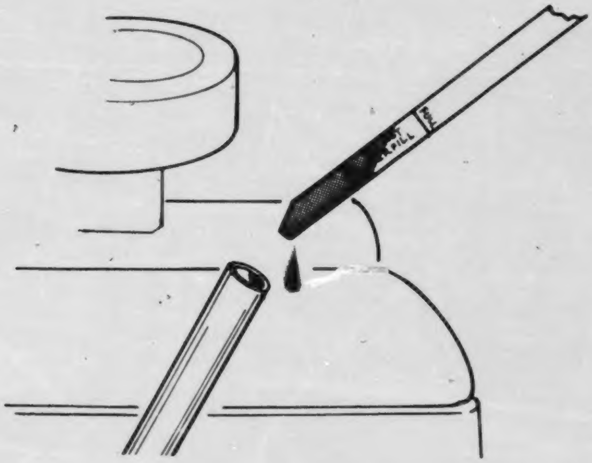
I. Tools and materials required

- A. Shop towel
- B. Oil, if needed
- C. Oil spout

II. Procedure

(NOTE: Follow all safety rules)

- A. Park car on level ground and allow to sit for a few minutes with the motor off.
- B. Raise hood.
- C. Locate dipstick.
- D. Remove dipstick.
- E. Wipe off dipstick with shop towel.
- F. Put dipstick back into dipstick tube and push down as far as possible.
- G. Remove dipstick.
- H. Read the oil level on the dipstick markings.



I. Put dipstick back into dipstick tube.

J. Add the correct amount of oil that the dipstick indicates the crankcase needs.

K. If oil is added, recheck the oil level.

L. Close the car hood.

M. Clean the work station and any spilled oil.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #2--CHANGE ENGINE OIL

I. Tools and materials required

A. Shop towel

B. Proper size wrench

C. Drain pan

D. Oil (usually five quarts when filter is replaced)

E. Oil spout

F. Hydraulic floor jack

G. Two jack stands

H. Fender cover

II. Procedure

(NOTE: Follow all safety rules)

A. Raise the car enough to place jack stands.

(NOTE: Use hydraulic lift if available.)

B. Place jack stands under frame of car.

C. Place the drain pan under the drain plug.

D. Remove oil pan drain plug.

(CAUTION: Oil may be hot.)

E. Let oil drain completely.

F. Install oil pan drain plug

(CAUTION: Tighten the plug securely but be careful not to strip the threads.)

G. Raise car and remove jack stands and let down slowly.

H. Raise hood and put on fender cover.

I. Go to Job Sheet #3 if the engine oil filter needs to be replaced.

J. If the filter is not to be replaced, remove the oil filler cap.

K. Put in correct amount of oil.

L. Install oil filler cap.

M. Check the engine oil level.

N. Add oil, if necessary.

O. Close the car hood.

P. Dispose of used oil.

Q. Clean work station and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #3--CHANGE ENGINE OIL FILTER (SCREW-ON TYPE)

I. Tools and materials required

- A. Shop towel
- B. Oil filter wrench
- C. New oil filter
- D. Drain pan
- E. Fender cover

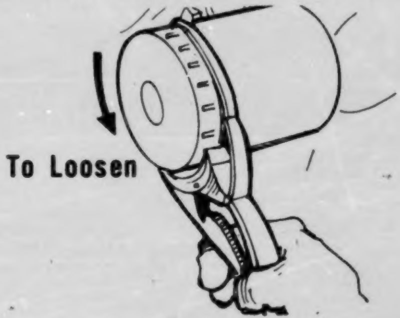
II. Procedure

(NOTE: Follow all safety rules.)

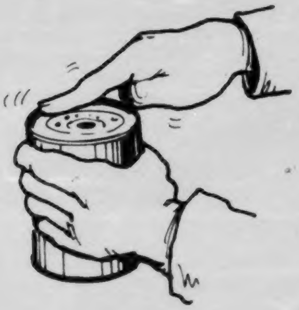
A. Open car hood and put on fender cover.

B. Put drain pan under oil filter area.

C. Remove the oil filter with the oil filter wrench by turning the filter counterclockwise.



D. Rub oil on the surface of the gasket on the new filter.



E. Run the filter up on the threads until the gasket touches the base.

(NOTE: Clean the base, before installing a filter.)

F. Turn the filter one-half of a turn more.

G. Follow Job Sheet #2 instructions for oil filling.

H. After engine has been filled to the proper oil level, place transmission in neutral and set parking brake.

I. Start engine and allow it to warm up.

J. Switch off engine.

K. Check for oil leaks around filter and drain plug.

L. Check oil level on dipstick and add oil if necessary.

M. Close hood.

N. Clean work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #4--CHECK AUTOMATIC TRANSMISSION FLUID LEVEL

I. Tools and materials required

- A. Shop towel
- B. Transmission fluid
- C. Funnel
- D. Fender cover

II. Procedure

(NOTE: Follow all safety rules.)

- A. Place transmission in park and secure parking brake.
- B. Start the engine and allow it to warm to normal operating temperature. (170° - 180°)
- C. Switch off the engine.
- D. Raise the car hood and put on the fender cover.
- E. Locate the transmission dipstick and remove.
- F. Wipe off the dipstick with a rag.
- G. Put the dipstick back into the tube and push in as far as possible.
- H. Remove the dipstick and read the fluid level on the dipstick markings.
- I. Add fluid in the dipstick tube if the fluid reading on the dipstick shows to be low.

  (NOTE: Usually one quart is required if the oil level is on add.)
- J. Replace dipstick.
- K. Close hood.
- L. Clean work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #5--CHANGE AUTOMATIC TRANSMISSION FLUID

I. Tools and materials required

- A. Shop towel
- B. Proper size wrench to remove drain plug
- C. Drain pan
- D. Transmission fluid as required
- E. Funnel
- F. Hydraulic floor jack
- G. Two jack stands
- H. Fender cover

II. Procedure

(NOTE: Follow all safety rules.)

- A. Place transmission in neutral and secure parking brake.
- B. Start engine and allow it to warm up to normal operating temperature.
- C. Switch off engine.
- D. Raise car to necessary height.

  (NOTE: Use hydraulic lift if available.)
- E. Place jack stands under frame of vehicle.
- F. Place drain pan in proper location.
- G. Remove drain plug.

  (CAUTION: Fluid may be hot enough to burn.)
- H. Allow transmission to drain completely.
- I. Install drain plug.

J. Remove rack stands and lower slowly to floor.

K. Raise hood and put fender cover in place.

L. Remove dipstick.

M. Add new fluid.

(NOTE: Add only about half as much fluid as was drained.)

N. Start the engine and allow to warm up.

O. Check fluid level and check for leaks.

P. Add fluid necessary to bring the fluid level to the full mark on the dipstick.

Q. Switch off engine.

R. Close hood.

S. Clean work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #6--CHECK STANDARD TRANSMISSION OIL LEVEL

I. Tools and materials required

   A. Shop towel

   B. Transmission oil

   C. Wrench to fit transmission plug

   D. Hydraulic floor jack

   E. Two jack stands

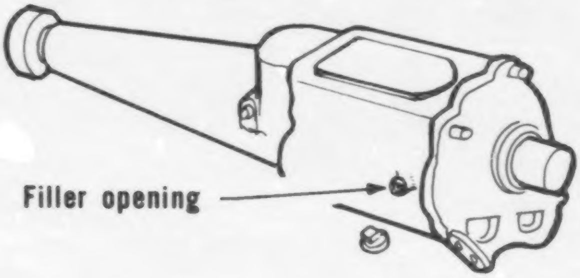
II. Procedure

   (NOTE: Follow all safety rules.)

   A. Raise car enough to place jack stands.

   B. Place jack stands under frame of car.

   C. Locate filler plug on transmission and remove.



   D. Place transmission filler spout in filler opening.

   E. Add transmission oil until it runs out the filler hole.

   F. Install the filler plug and tighten securely.

   G. Remove jack stands and lower the car to the floor.

   H. Clean the work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #7--CHECK DIFFERENTIAL OIL LEVEL

I. Tools and materials required

A. Shop towel

B. Wrench to fit differential plug

C. Transmission oil

D. Hydraulic floor jack

E. Two jack stands

II. Procedure

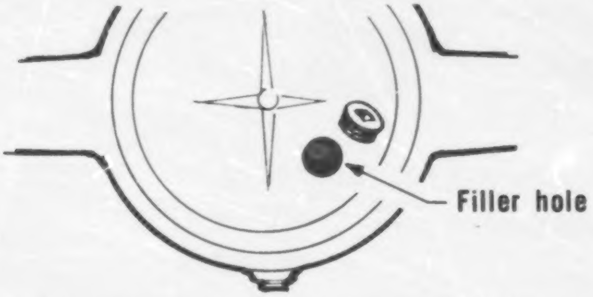
(NOTE: Follow all safety rules.)

A. Raise car high enough to place jack stands.

B. Place jack stands under frame of car.

C. Locate the differential filler plug and remove.

D. Insert the filler spout in the filler hole.



E. Add oil until it runs out the filler hole.

F. Install the filler plug and tighten securely.

G. Remove jack stands and lower the car to the floor.

H. Clean work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #8--CHECK MANUAL STEERING GEAR OIL LEVEL

I. Tools and materials required

   A. Shop towel

   B. Wrench to fit manual steering plug

   C. Fender cover

   D. Gear oil

II. Procedure

   (NOTE: Follow all safety rules.)

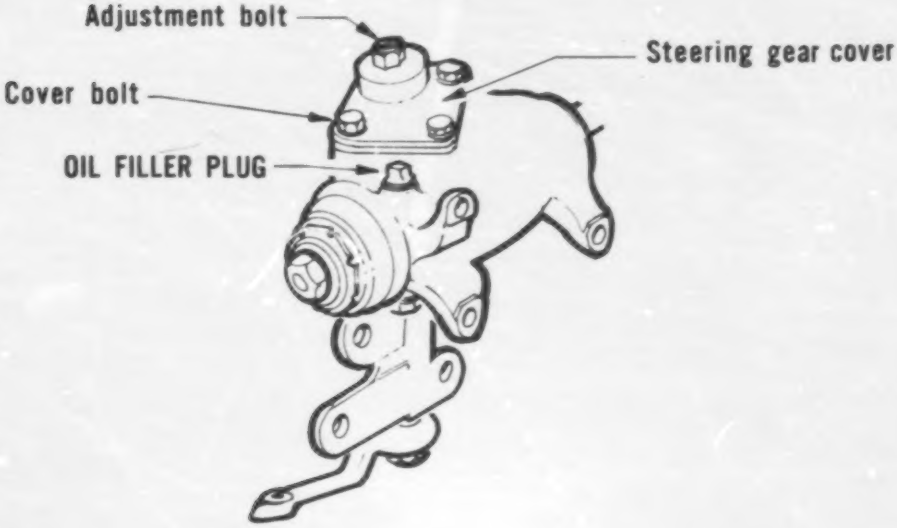
   A. Raise hood and put on fender cover.

   B. Locate oil filler plug on steering gearbox.

      (NOTE: Do not mistake the steering gear adjustment nut and screw for the filler plug.)

   C. Remove the plug.

      (NOTE: A cover bolt must be removed on some steering gearboxes to check the oil level.)


Adjustment bolt
Steering gear cover
Cover bolt
OIL FILLER PLUG

D. Add oil until it can be seen through the filler hole.

E. Install the plug.

F. Close hood.

G. Clean work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #9--CHECK POWER STEERING PUMP OIL LEVEL

I. Tools and materials required

   A. Shop towel

   B. Power steering oil

   C. Fender cover

II. Procedures

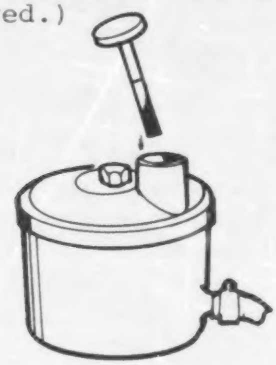
   (NOTE: Follow all safety rules.)

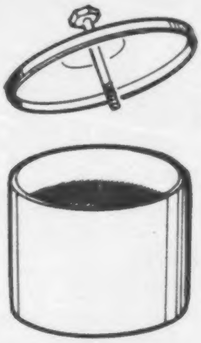
   A. Raise hood and put on fender cover.

   B. Clean the top of the pump around the dipstick.

   C. Remove the dipstick and wipe clean.

      (NOTE: Some models have a cover which must be removed.)





   D. Push the dipstick back into the power steering pump.

   E. Remove the dipstick and read the oil level on the dipstick markings.

   F. Add oil through the dipstick tube if necessary.

   G. Close hood.

   H. Clean the work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

JOB SHEET #10--LUBRICATE CHASSIS

I. Tools and materials required

   A. Shop towel

   B. Grease gun and grease

   C. Auto service manual

   D. Hydraulic floor jack

   E. Two jack stands

II. Procedure

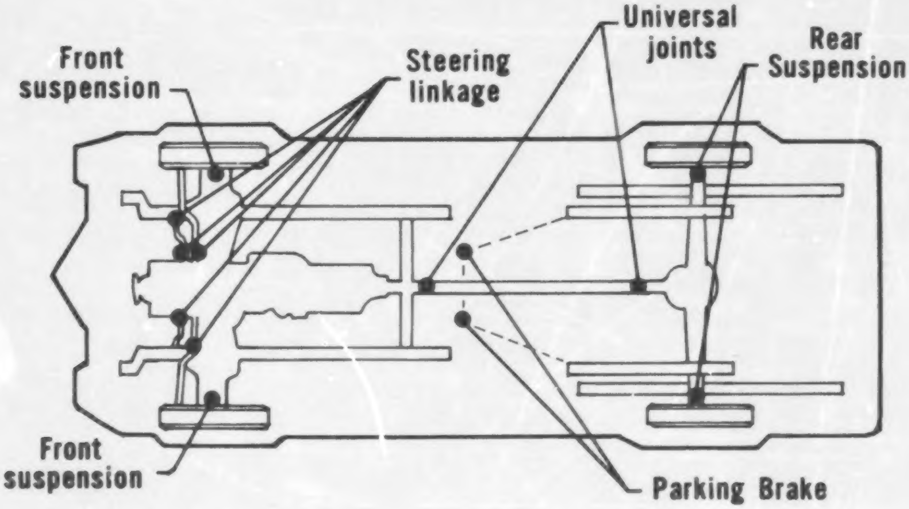
   (NOTE: Follow all safety rules.)

   A. Raise car high enough to place the jack stands.

   B. Place jack stands under the frame of the car.

   C. Refer to the auto service manual for locating the car's lubrication points.

   D. Locate the lubrication fittings on the car.


Front suspension
Steering linkage
Universal joints
Rear Suspension
Front suspension
Parking Brake

E. If plugs are in the lube points, remove plugs and install grease fittings.

F. Wipe grease fittings clean.

G. Push grease gun nozzle onto fitting.

H. Pump grease gun until grease squeezes out around the edges of the unit being greased.

I. Grease all fittings on the car.

J. Check all gear boxes for the proper oil level.

(EXAMPLE: Differential, steering, transmission, etc.)

K. Remove jack stands and lower car to the floor.

L. Clean work area and turn in tools.

UNIT VII

LUBRICATION SYSTEM

UNIT TEST

1. Explain the purpose of the lubrication system.

2. Match the terms on the right to the correct definition associated with the lubrication system.

_____a. Resistance to any motion between two surfaces in contact

_____b. A by-product made from petroleum; used for lubrication

_____c. A device used to prevent oil leakage past a certain point of the engine

_____d. A part of the lubrication system used to clean the oil

_____e. A device used to force oil through the engine

_____f. Unit using oil to clean air entering the engine

_____g. Any material used to prevent friction between two surfaces

_____h. A unit that drives both rear axles, but will allow them to turn at different speeds when making turns

_____i. A material or solution added to a mixture to increase efficiency

_____j. A metal stick used to measure the oil level in an engine or automatic transmission

_____k. Society of Automotive Engineers

1. Oil
2. S.A.E.
3. Sump
4. Friction
5. Additive
6. M.L.
7. Oil seal
8. Oil pump
9. M.M.
10. Differential
11. Lubricant
12. M.S.
13. Dipstick
14. Oil Filter
15. Oil bath cleaner

_____l. Motor light

_____m. Motor medium

_____n. Motor severe

_____o. The part of the engine that holds the oil

3. Point out the five functions of oil by underlining the letter in front of each correct answer.

   a. Cools

   b. Softens

   c. Cleans

   d. Glues

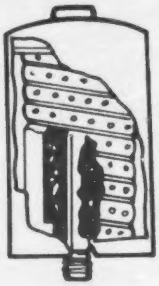
   e. Cushions

   f. Lubricates

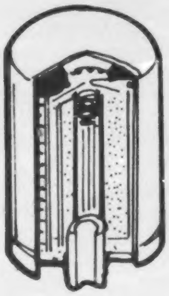
   g. Seals

4. Select the proper type of oil filter by writing the correct name for each of the following filters.

   a.



   b.



5. Pick out the types of lubrication systems from the following list by underlining each correct answer.

   a. Slow-drip oiling

   b. Full-pressure oiling

   c. Splash oiling

   d. Combination slow-drip and splash oiling

   e. Combination full-pressure and splash oiling

6. Point out the factors that cause lubricants to break down by writing yes or no in front of each of the following.

_____a. Moisture

_____b. Freezing

_____c. Sunlight

_____d. Excessive heat

_____e. Dirt

_____f. Misuse

_____g. High engine RPM

7. Choose from the list at right the correct type of lubricant used in each of the vehicle areas listed at left.

_____a. For use in the engine

_____b. Used on ball joints, wheel bearnings, and u-joints

_____c. For use in the transmission

_____d. Used on rubber mountings and joints

_____e. For air-conditioning or power steering units

1. Grease
2. Gear oil
3. Motor oil
4. Chassis lubricant
5. Accessory lubricant

8. Demonstrate the ability to:

a. Check engine oil level.

b. Change engine oil.

c. Change engine oil filter.

d. Check automatic transmission fluid level.

e. Change automatic transmission fluid.

f. Check standard transmission oil level.

g. Check differential oil level.

h. Check manual steering gear oil level.

i. Check power steering pump level.

j. Lubricate chassis.

(NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT VII

LUBRICATION SYSTEM

ANSWERS TO TEST

1. The purpose of the lubrication system is to reduce friction throughtout the automobile by means of oil, or grease, making the automobile a more economical, longer-lasting vehicle.

2.
4 a.
1 b.
7 c.
14 d.
8 e.
15 f.
11 g.
10 h.
5 i.
13 j.
2 k.
6 l.
9 m.
12 n.
3 o.

3.
a
c
e
f
g

4.
a. Permanent type
b. Throw-away

5.
b. Full-pressure oiling
c. Splash oiling
e. Combination full-pressure and splash oiling

6.
yes a.
yes b.
no c.
yes d.
yes e.
yes f.
no g.

7. __3__ a.

__1__ b.

__2__ c.

__4__ d

__5__ e.

8. Evaluated to the satisfaction of the instructor.

UNIT VIII

ENGINE COOLING SYSTEM

UNIT OBJECTIVE

After completion of this unit, the student will be able to identify the parts of the cooling system and explain the purpose of each. The student will be able to inspect, test, and service parts within the cooling system. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the cooling system.
2. Point out the three functions of the cooling system.
3. Match the terms with the definitions associated with the cooling system.
4. Select the correct type of thermostat.
5. Point out the types and uses of anti-freeze.
6. Demonstrate the ability to:
    a. Replace the radiator.
    b. Pressure check the radiator.
    c. Pressure check the radiator cap.
    d. Remove and replace the water pump.
    e. Inspect the water pump.
    f. Remove and replace the thermostat.
    g. Test the thermostat for operation of the car.
    h. Remove, inspect, and replace the hoses.
    i. Inspect the fan belts and set the tension.
    j. Test, remove, and replace the fan clutch.

UNIT VIII

ENGINE COOLING SYSTEM

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and job sheets.

   F. Demonstrate the procedures outlined on the job sheets.

   G. Give test.

II. Students

   A. Read objectives.

   B. Study information sheet.

   C. Complete each assignment sheet.

   D. Perform the jobs outlined on the job sheets.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM-1--The Cooling System

      2. TM-2--The Radiator

      3. TM-3--Radiator Tubes and Fins

4. TM-4--Types of Thermostats

5. TM-5--The Water Pump

6. TM-6--The Fan

7. TM-7--The Temperature Indicator System

D. Job sheets

1. Job Sheet #1--Replace the Radiator

2. Job Sheet #2--Pressure Check the Radiator

3. Job Sheet #3--Pressure Check the Radiator Cap

4. Job Sheet #4--Remove and Replace the Water Pump

5. Job Sheet #5--Inspect the Water Pump

6. Job Sheet #6--Remove and Replace the Thermostat

7. Job Sheet #7--Test the Thermostat for Operation off of the Car

8. Job Sheet #8--Remove, Inspect, and Replace the Hoses

9. Job Sheet #9--Inspect the Fan Belts and Set the Tension

10. Job Sheet #10--Test, Remove, and Replace the Fan Clutch

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. *Auto Mechanics Fundamentals*. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1974.

B. Stockel, Martin W. *Auto Service and Repair*. South Holland, Illinois: The Goodheart-Wilcox Company, Inc. 1975.

C. Glenn, Harold T. *Automechanics*. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1962.

UNIT VIII

ENGINE COOLING SYSTEM

INFORMATION SHEET

I. The purpose of the cooling system is to relieve heat generated by explosion in the engine cylinders by transferring the heat to the water in the water jackets running through the block, and then transporting it through the hoses to the radiator where it leaves the system by air being drawn through the radiator by the fan.

II. Three functions of the cooling system

  A. Brings coolant and engine up to operating temperature quickly

  B. Keeps coolant and engine at an even temperature

  C. Removes unwanted heat

III. Terms and definitions

  A. Radiator--A square unit filled with coolant, located in front of the engine, from which heat generated in the engine leaves the system

  B. Water pump--A unit designed to move coolant through the cooling system

  C. Thermostat--A unit, located in the engine head outlet, that controls engine coolant temperature

  D. Hoses--Connect radiator to engine and water pump

  E. Radiator cap--Seals the radiator and allows the system to operate under pressure

  F. Anti-freeze--A liquid made of ethylene glycol that prevents the coolant from freezing and aids in overheating problems

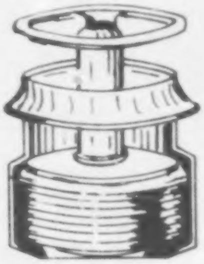
  G. Fan--A unit located to the rear of the radiator that is driven by belts from the crankshaft and pulls air through the radiator

  H. Fan clutch--A device mounted on the fan hub that allows the fan to cut out at speeds over 50 miles per hour to give extra power from the engine at high speeds

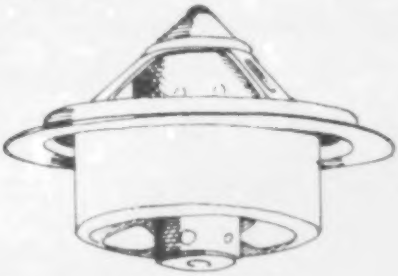
I. Belt--A flexible rubber and steel strap used to drive the water pump from the crankshaft by pulleys

III. Types of thermostats

A. Bellows--A low-pressure thermostat that contains a liquid which creates pressure upon evaporation, causing the valve to open



B. Pellet--A high-pressure thermostat that uses a wax pellet which expands with temperature, causing a valve to open



IV. Anti-freeze

A. Types

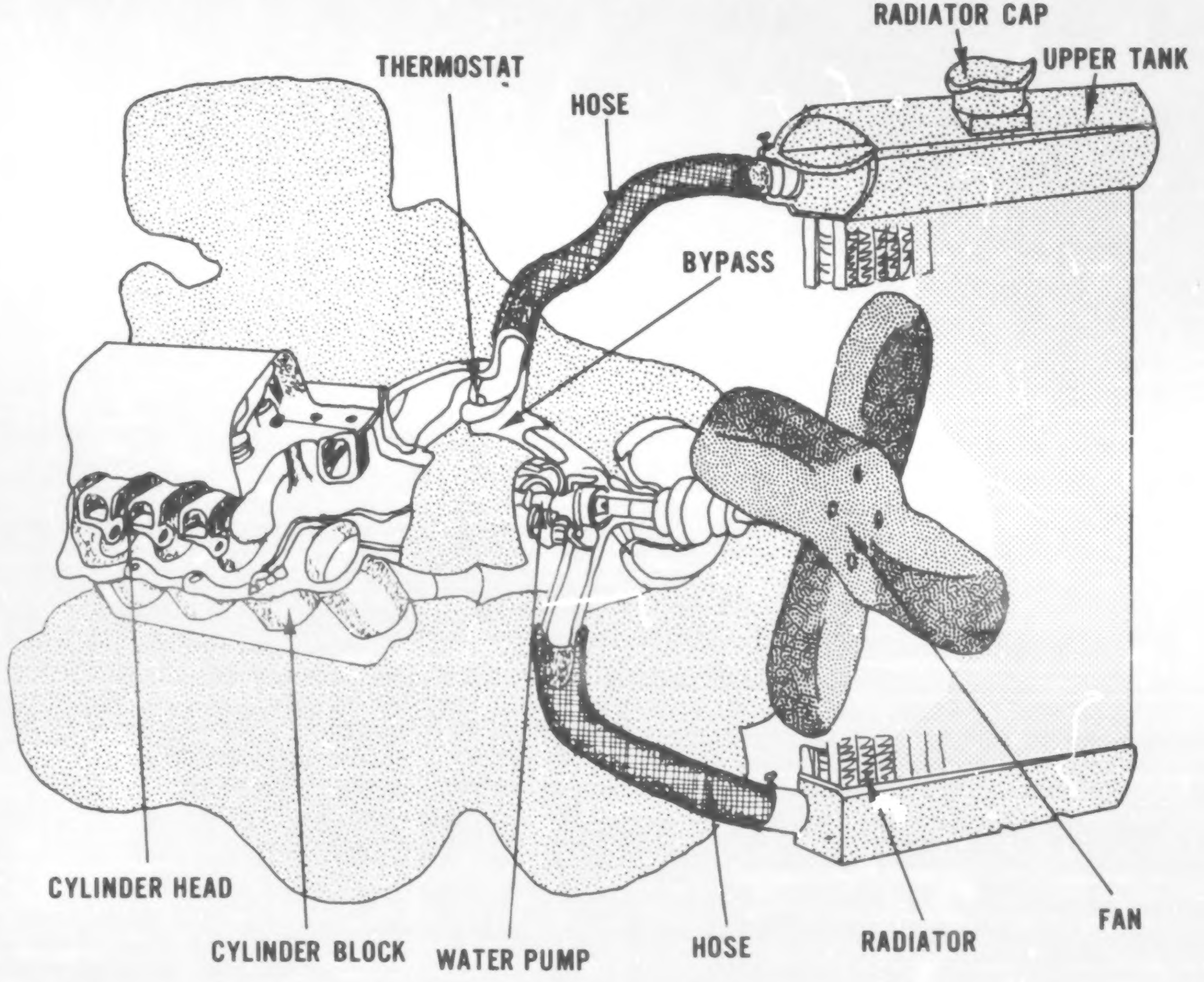
1. Permanent ethylene glycol
2. Replaceable alcohol

B. Characteristics of anti-freeze

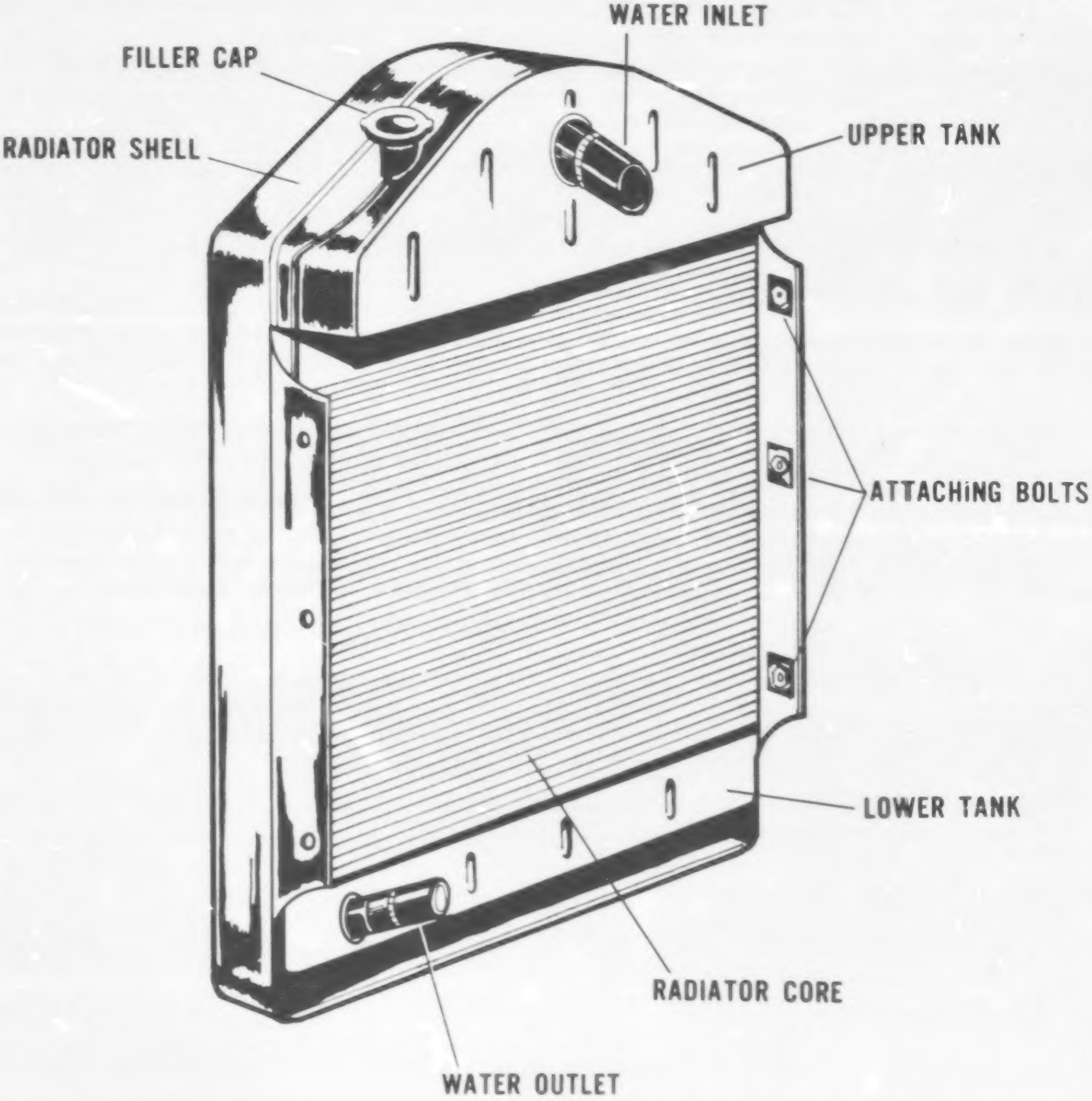
1. It has a much lower freezing point than water
2. The ethylene glycol type prevents boil over during hot weather
3. It is poisonous if swallowed
4. The useful life of most anti-freeze is 24 months

5. It will remove paint from car bodies and should be cleaned up immediately if spilled

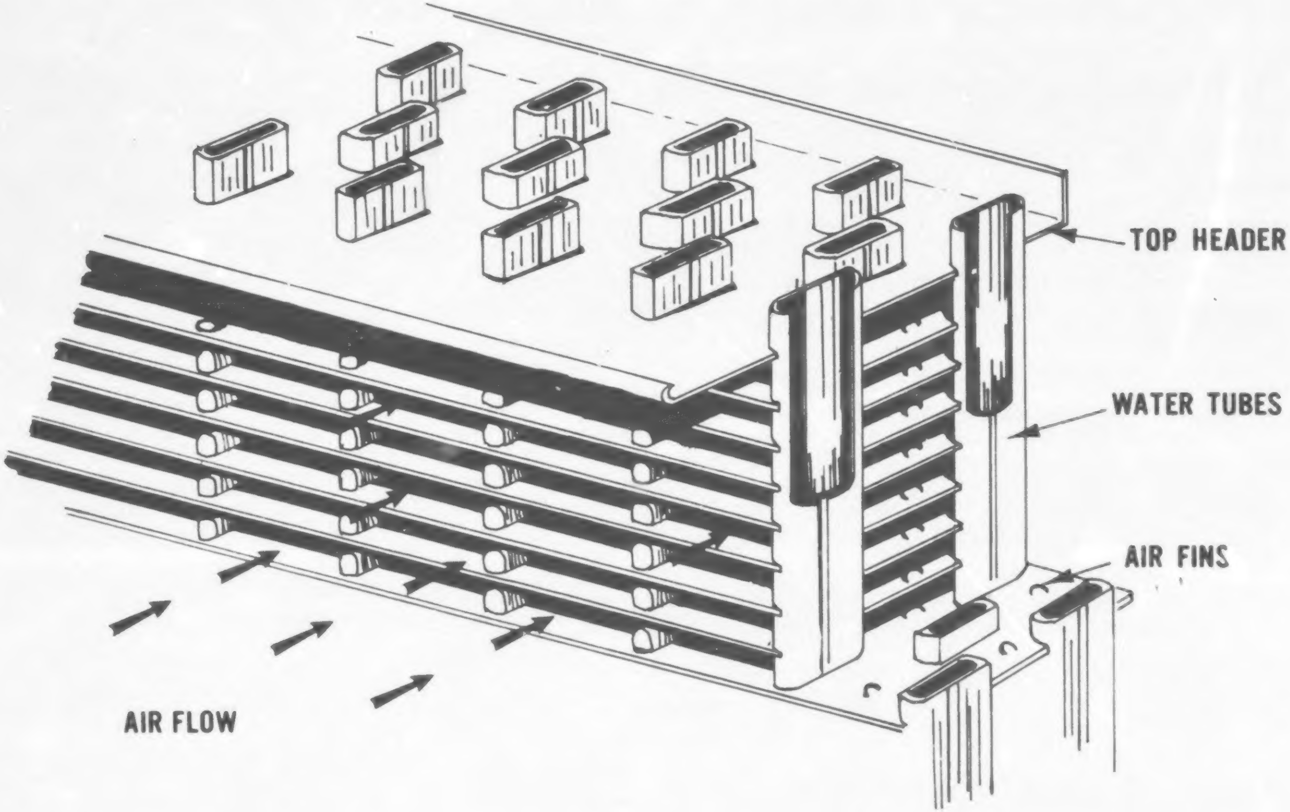
THE COOLING SYSTEM


RADIATOR CAP
UPPER TANK
THERMOSTAT
HOSE
BYPASS
CYLINDER HEAD
CYLINDER BLOCK
WATER PUMP
HOSE
RADIATOR
FAN

THE RADIATOR


WATER INLET
FILLER CAP
RADIATOR SHELL
UPPER TANK
ATTACHING BOLTS
LOWER TANK
RADIATOR CORE
WATER OUTLET

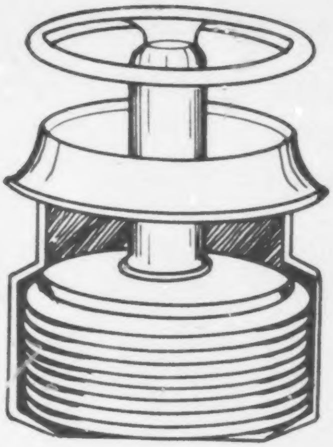
RADIATOR TUBES AND FINS


TOP HEADER
WATER TUBES
AIR FINS
AIR FLOW

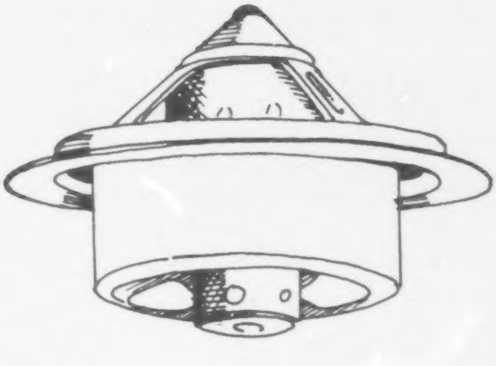
279

278

TYPES OF THERMOSTATS



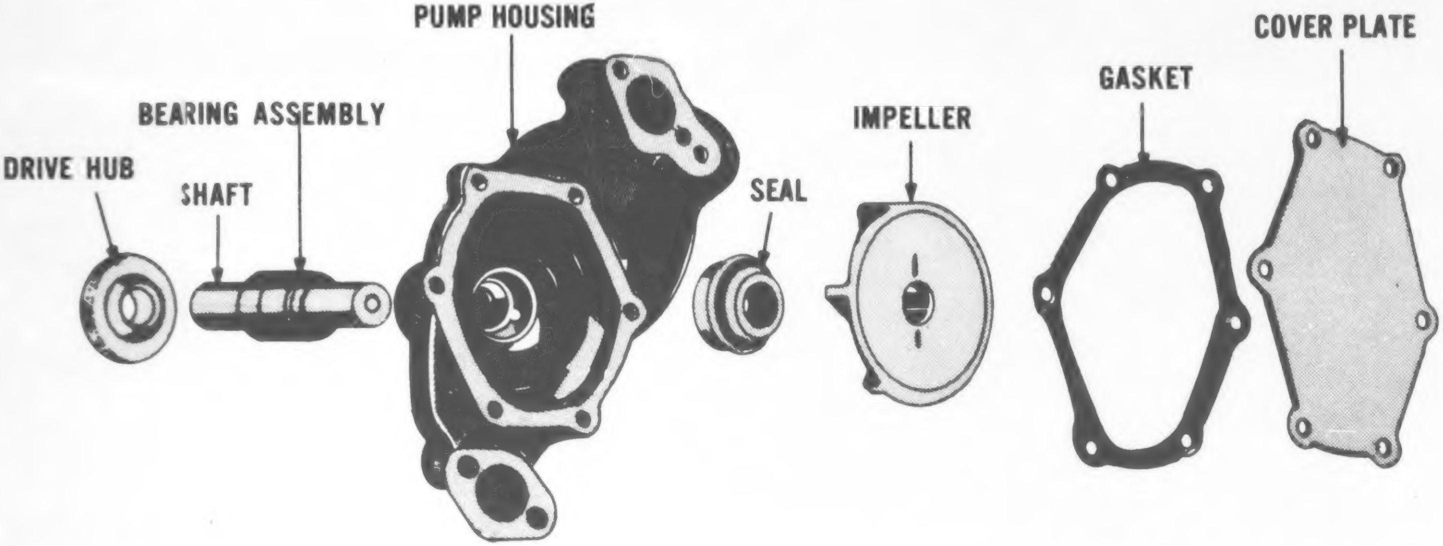
BELLOWS



PELLET

280

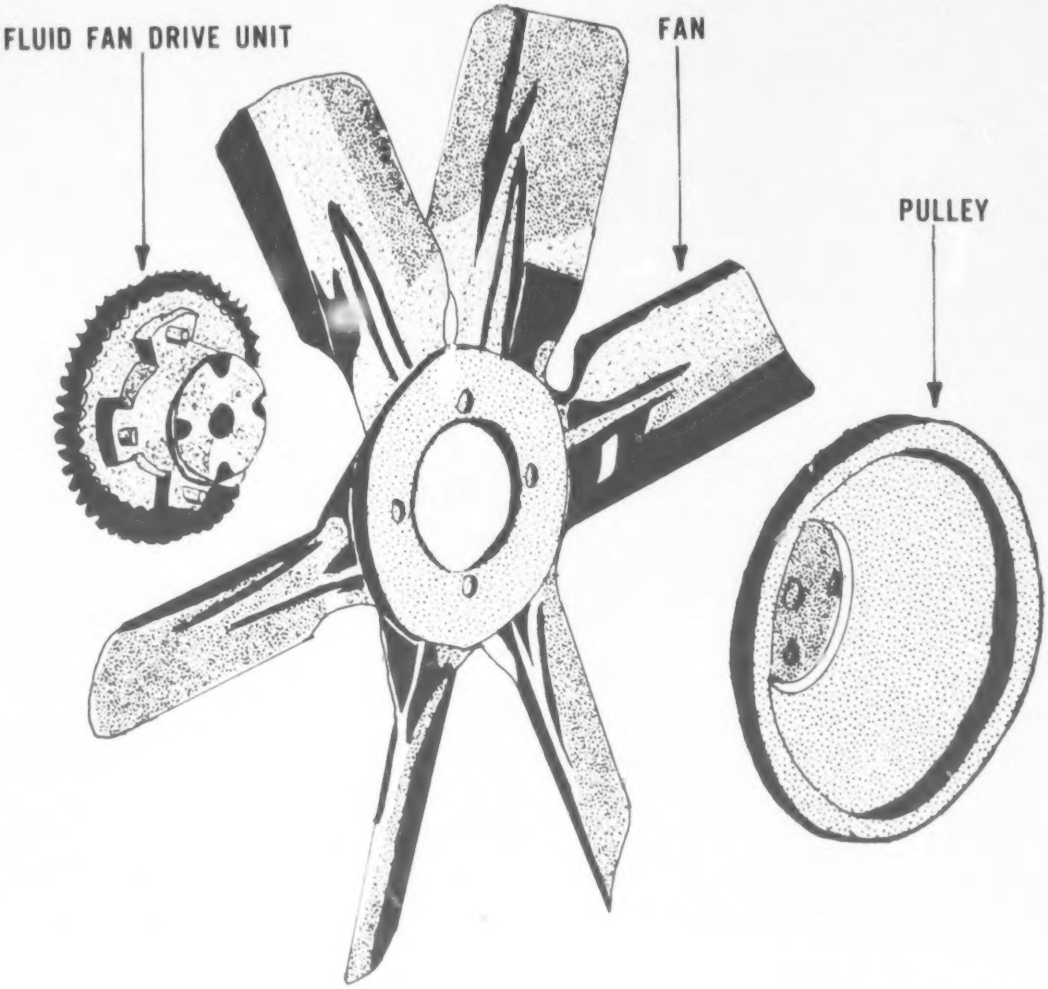
THE WATER PUMP


PUMP HOUSING
COVER PLATE
GASKET
BEARING ASSEMBLY
IMPELLER
DRIVE HUB
SHAFT
SEAL

282

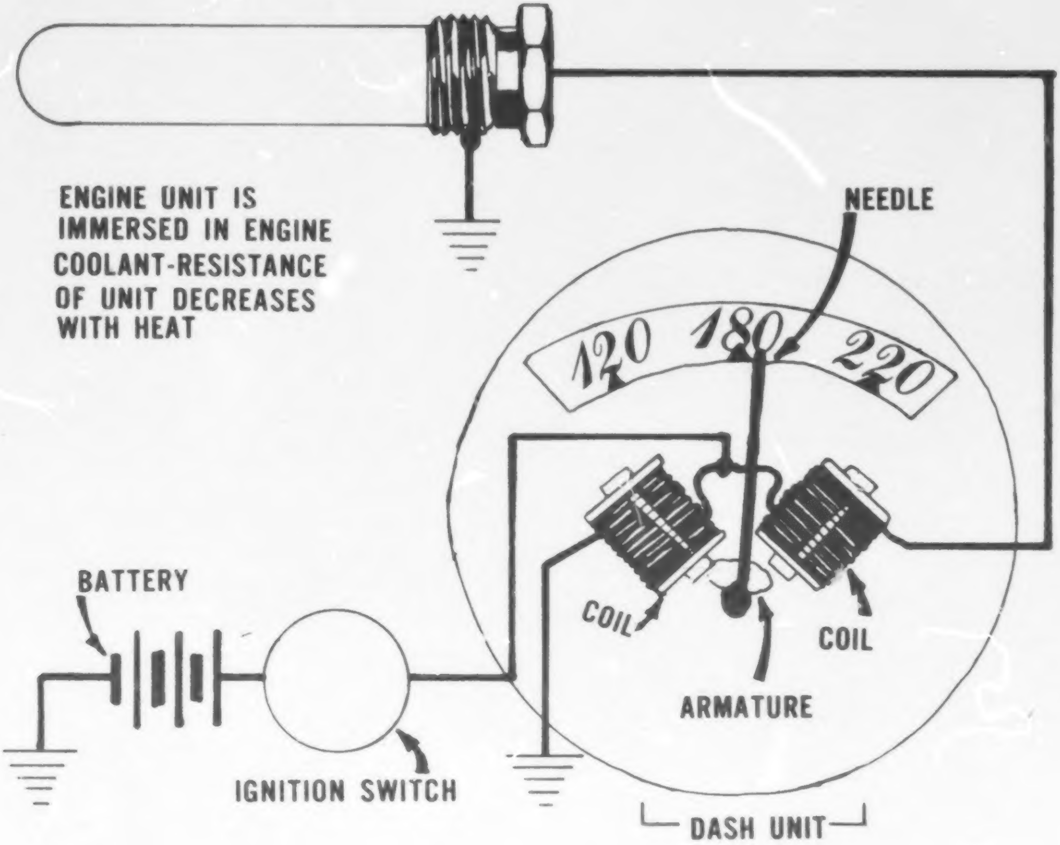
281

THE FAN

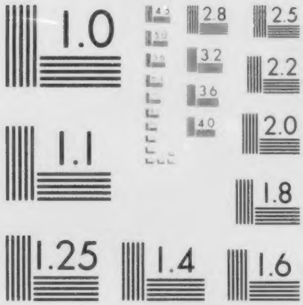

FLUID FAN DRIVE UNIT
FAN
PULLEY

283

THE TEMPERATURE INDICATOR SYSTEM


ENGINE UNIT IS IMMERSED IN ENGINE COOLANT-RESISTANCE OF UNIT DECREASES WITH HEAT
NEEDLE
120
180
220
BATTERY
COIL
COIL
ARMATURE
IGNITION SWITCH
DASH UNIT

2B


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963 A

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #1--REPLACE RADIATOR

I. Tools and materials required

A. 3/8" drive socket set

B. Common screwdriver

C. Two 1/2" x 9/16" open-end wrenches

D. Hose clamp pliers

E. Drain container

F. Fender cover

II. Procedure

(NOTE: Follow safety rules.)

A. Place transmission in neutral and set parking brake.

B. Raise the car hood and put on the finder cover.

C. Remove the radiator cap.

(CAUTION: If the engine is hot, allow it to cool before removing the radiator cap.)

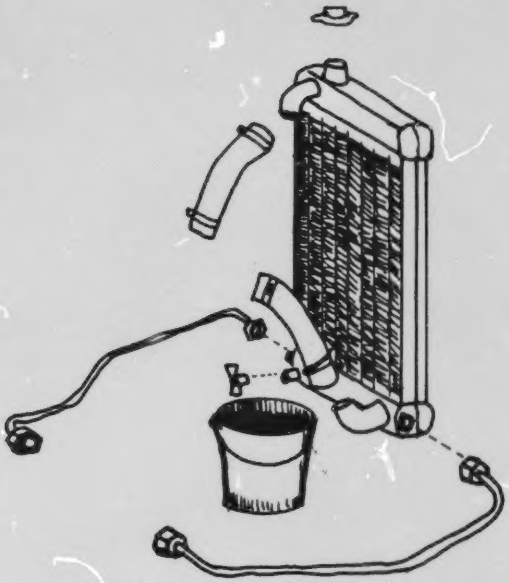
D. Drain the radiator into a drain pan by opening the drain cock at the bottom of the radiator.

(NOTE: The drain cock turns to the left to open.)

E. Remove the top and the bottom radiator hoses with a common screwdriver or hose-clamp pliers.

F. If the radiator has automatic transmission lines running through it, remove them using the open end wrenches.

(NOTE: Use one wrench to hold the radiator fitting in place while loosening the lines.)



G. Remove the radiator mount bolts with the socket set.

H. Lift the radiator upward and out of the vehicle.

I. When the radiator is to be installed, slide it into place on the frame.

J. Install the mount bolts, using the socket set.

K. Connect the transmission lines at the bottom of the radiator and tighten, using both open-end wrenches.

L. Replace the top and bottom radiator hoses.

(NOTE: Use a lightweight grease inside the hose ends to aid in putting them on.)

M. Secure hose clamps with common screwdriver or hose clamp pliers.

N. Close the drain cock at the bottom of the radiator by turning it clockwise.

O. Replace the coolant in the radiator, leaving two inches for air space at the top.

P. Install the radiator cap.

Q. Start engine and allow it to warm up.

R. Switch off engine and check for leaks around hoses and fittings.

S. Close the car hood.

T. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #2--PRESSURE-CHECK RADIATOR

I. Tools and materials required

A. Cooling system pressure tester

B. Fender cover

C. Auto service manual

II. Procedure

(NOTE: Follow all safety rules.)

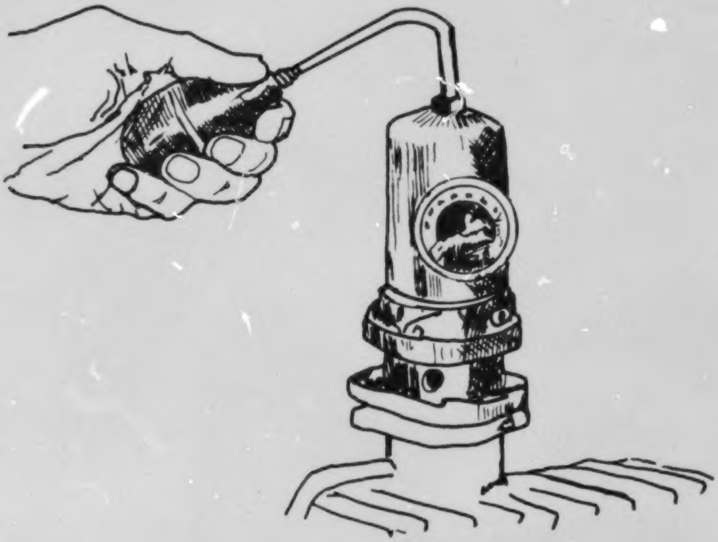
A. Place the transmission in neutral and set the parking brake.

B. Raise the hood and put on the fender cover.

C. Remove the radiator cap.

(CAUTION: If the engine is hot, allow it to cool before removing the radiator cap.)

D. Attach the cooling system tester to the radiator.



E. Look in the auto service manual or on the radiator cap of the system being tested to find the correct pressure required.

F. Build up pressure in the system to the amount specified in the auto service manual or on the cap.

G. After the pressure is built up to the correct amount, watch the gauge for changes.

(NOTE: The system should hold steady pressure for 2 minutes.)

H. If the pressure drops, check all areas for leaks.

I. If no leaks are visible, check the connection of the pressure tester to the radiator at the filler neck.

J. Start the engine and allow to warm up to operating temperature.

(NOTE: Some systems show leaks only when warm.)

K. Turn off engine and pressurize the radiator.

L. When pressure test is completed, return the water level to within 2 inches of the top of the radiator.

M. Replace the radiator cap.

N. Close the car hood.

O. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #3--PRESSURE CHECK RADIATOR CAP

I. Tools and materials required

   A. Cooling system pressure tester

   B. Fender cover

   C. New radiator cap

II. Procedure

   A. Raise hood and put on the fender cover.

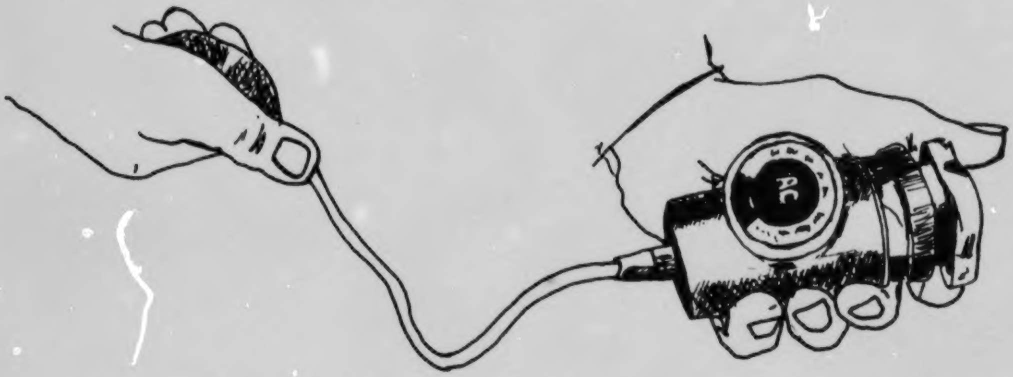
   B. Remove radiator cap.

   C. Read the pressure limits on the cap.

   D. Check the rubber seal for cracks at the base of the cap.

   E. Install the cap on the tester adapter.

   F. Pump up the pressure to the limit shown on the cap.



   G. Watch the tester gauge.

   H. If pressure gauge goes rapidly, wet the rubber surfaces on the cap and adapter and recheck.

   (NOTE: If the pressure holds, the cap is good.)

I. If the pressure goes down again, check the new cap against the old one.

(If the new cap will hold pressure, the old one is bad and should be replaced.)

J. Install a good cap on the radiator.

K. Close the hood.

L. Clean the work area and turn in the tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #4--INSPECT WATER PUMP

I. Tools required

A. 3/8" drive socket set

B. Fender cover

II. Procedure

(NOTE: Follow all safety rules.)

A. Place transmission in neutral and set parking brake.

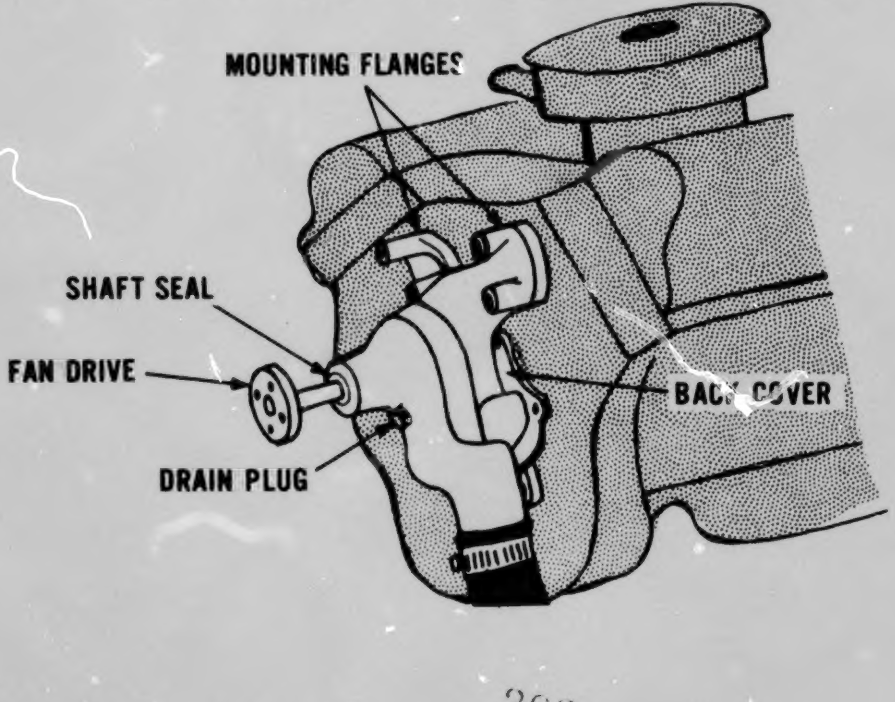
B. Raise the car hood and put on the fender cover.

C. Using the socket set, loosen all units driven by fan belts.

D. Check for worn water pump bearings and loose fan blades by working the fan blades back and forth.

(NOTE: Excess slack in the shaft would indicate bad water pump bearings.)

E. Look for leaks around the pump-mounting flanges.


MOUNTING FLANGES
SHAFT SEAL
FAN DRIVE
BACK COVER
DRAIN PLUG

F. Check the water pump shaft drain seal hole for leakage. (Located at the bottom of the pump.)

G. If no leaks are found, tighten fan belts.

H. If leaks are found, the pump should be changed or taken off and leaks repaired, as described on Job Sheet #5.

I. Close the car hood.

J. Clean work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #5--REMOVE AND REPLACE WATER PUMP

I. Tools and materials required

A. 3/8" drive socket set

B. Hose clamp pliers

C. Common screwdriver

D. Scraper

E. Drain container

F. Fender cover

G. Gasket sealant

II. Procedure

(NOTE: Follow all safety rules.)

A. Place transmission in neutral and set parking brake.

B. Raise the hood and put on the fender cover.

C. Remove the radiator cap.

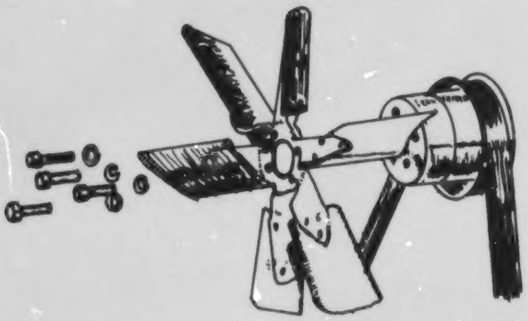
(CAUTION: If the engine is hot, allow it to cool before removing the radiator cap.)

D. Place the drain container under the radiator drain cock and drain the coolant to below the top neck of the radiator.

E. Remove the bottom radiator hose from the water pump, using a common screwdriver or hose clamp pliers.

F. Remove the fan shroud mounting bolts, using the socket set.

G. Remove the fan by removing the four mount bolts in the center of the fan, using the socket set.



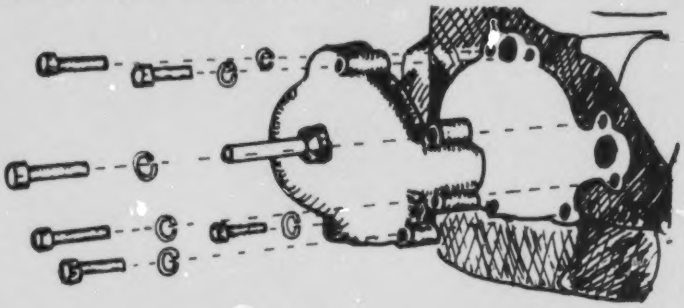
H. Lift fan and shroud out together.

I. Remove any mount brackets attached to the water pump, using the socket set.

J. Lift the fan pulley off the water pump.

(NOTE: Keep belts straight for later installation.)

K. Remove the water pump by removing the mounting bolts with a socket set.



L. Clean the gasket surfaces on the engine block with a scraper.

M. Apply a gasket sealant to the gasket sides and the pump mount surface on the engine.

N. Set a new pump with the coated gasket on the engine.

O. Install the mounting bolts and tighten securely.

P. Install the belt pulley.

Q. Set the correct belts into each of the pulley grooves.

R. Reinstall the pump brackets and tighten securely.

S. Install the fan and shroud at the same time, using the socket set.

T. Tighten all mounting bolts securely.

U. Replace the radiator hose to the water pump and tighten securely.

V. Replace the coolant to within 2 inches of the top of the radiator.

W. Install the radiator cap.

X. Check the system for coolant leaks.

Y. Close the hood.

Z. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #6--REMOVE AND REPLACE THERMOSTAT

I. Tools and materials required

- A. 3/8" drive socket set
- B. Hose clamp pliers
- C. Common screwdriver
- D. Gasket scraper
- E. Drain container
- F. Fender cover
- G. Gasket sealant

II. Procedure

(NOTE: Follow all safety rules.)

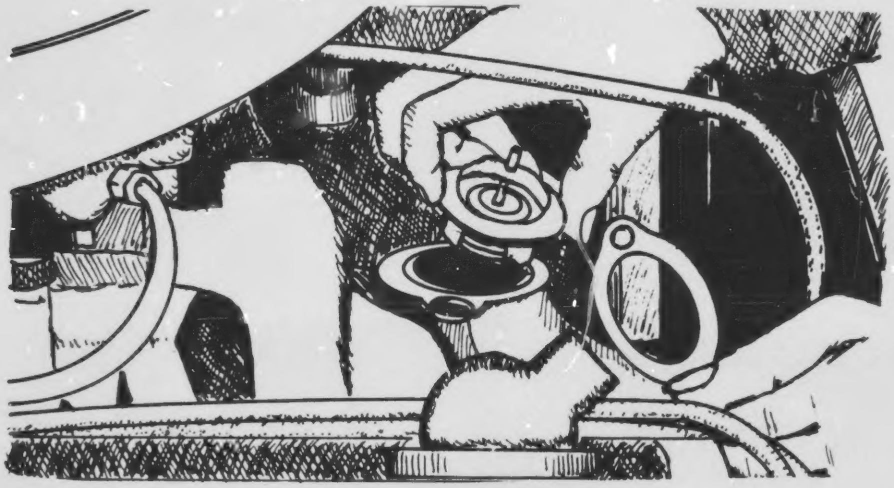
- A. Place transmission in neutral and set parking brake.
- B. Raise the car hood and put on the fender cover.
- C. Remove the radiator cap.

  (CAUTION: If the engine is not, allow it to cool.)
- D. Place the drain container under the radiator drain cock and drain the coolant to below the top neck of the radiator.
- E. Remove the top radiator hose at the engine, using a common screwdriver or hose clamp pliers.
- F. Remove the thermostat housing bolts and housing.
- G. Remove the thermostat.
- H. Scrape the old gasket from the thermostat housing and engine surface, using a scraper.
- I. Coat both sides of a new gasket with a gasket sealant.

J. Wipe any moisture from the housing and engine surface.

K. Install the new gasket on the surface of the engine.

L. Place a good thermostat in the engine-mount slot, with the pellet side down.



M. Install the thermostat housing and bolts.

N. Tighten securely with socket set.

O. Install top radiator hose to thermostat housing and tighten with a common screwdriver or hose clamps pliers.

P. Close the drain cock on the bottom of the radiator.

Q. Refill the radiator to within 2 inches of the top of the filler cap.

R. Install the radiator cap.

S. Check the hose and housing for leaks.

T. Close the hood.

U. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #7--TEST THERMOSTAT FOR OPERATION OFF THE CAR

I. Tools, equipment, and materials required

   A. A metal container with water

   B. Oxyacetylene welding unit

   C. Thermometer

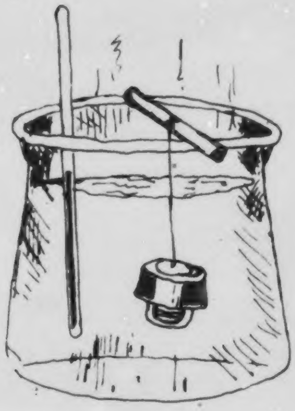
   D. A wire hook

II. Procedure

   A. Hand the thermostat from the wire hook, with the pellet side down, in the container of water.

   (CAUTION: Do not let the thermometer touch the sides or bottom of the container.)

   B. Using the oxyacetylene torch, heat the bottom of the container.



   C. Gently stir the water as the heat rises on the thermometer.

   D. Watch the thermostat for opening as the temperature rises.

   (NOTE: The thermostat should open within 10° of that marked on its base.)

6

E. Continue heating until the thermostat is fully open.

F. Check the thermometer for the temperature at which the thermostat fully opens.

(NOTE: It should be 20° to 24° above the temperature marked on the thermostat.)

G. Discard the thermostat if it does not work properly.

(NOTE: Do not attempt to repair the thermostat.)

H. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #8--REMOVE, INSPECT, AND REPLACE HOSES

I. Tools and materials required

   A. Common screwdriver

   B. Hose clamp pliers

   C. Drain container

   D. Fender cover

   E. Gasket sealant

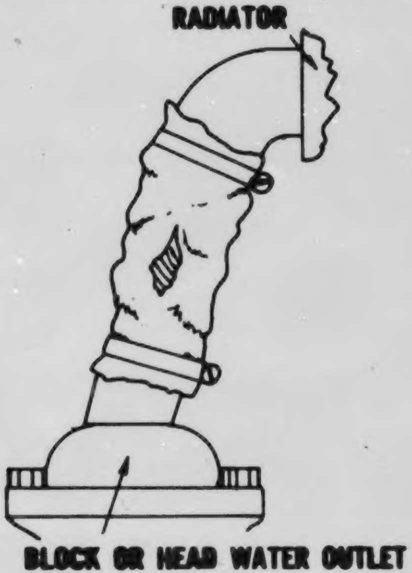
II. Procedure

   (NOTE: Follow all safety rules.)

   A. Place transmission in neutral and set parking brake.

   B. Raise the hood and put on the fender cover.

   C. Look at the hoses for signs of cracking, rot, hardness, softness, or collapsing.

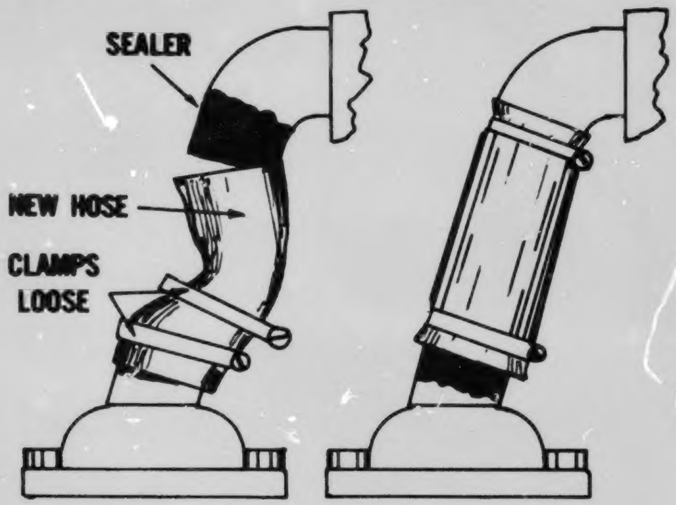


   D. Replace any hose that has a hole, crack or defect, that you can see.

E. Before you take off a bad hose, drain the radiator into the drain container.

F. Remove the bad hose, using a common screwdriver or hose clamp pliers.

G. Using a good gasket sealant, install a new hose where the old hose was removed.



H. Tighten the hose clamps securely, using a common screwdriver or hose clamp pliers.

I. Refill the radiator to within 2 inches of the top of the radiator.

J. Install the radiator cap.

K. Check for leaks at hose fittings.

L. Clean work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #9--INSPECT FAN BELTS AND SET TENSION

I. Tools and materials required

- A. Tension gauge
- B. Straightedge
- C. Ruler
- D. Fender cover
- E. Open-end, box-end wrench set

II. Procedure

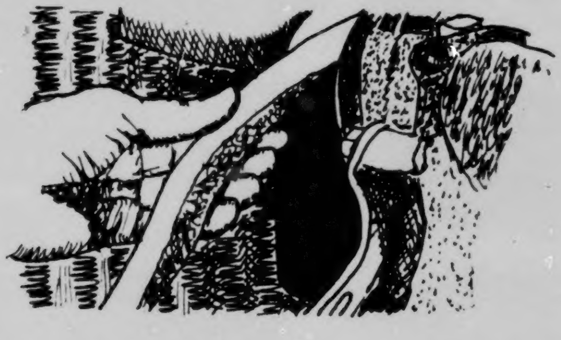
(NOTE: Follow all safety rules.)

A. Place transmission in neutral and set parking brake.

B. Raise the car hood and put on the fender cover.

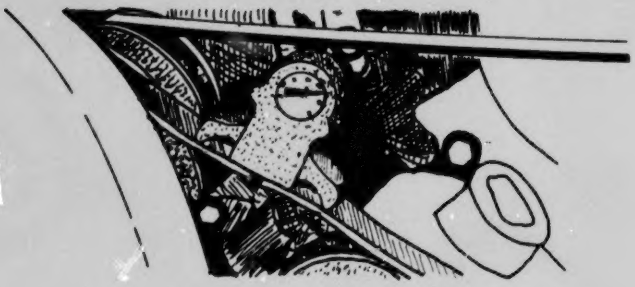
C. Look at all belts. Be sure to turn the belt over to see the bottom side.

(NOTE: Look for fraying, glazing, cracks, splitting, and oil-soaked conditions.)



D. If the belts have any of the conditions mentioned, replace the belts with new ones.

E. Using a belt tension gauge, check the belt tension to the specifications listed in the auto manual.

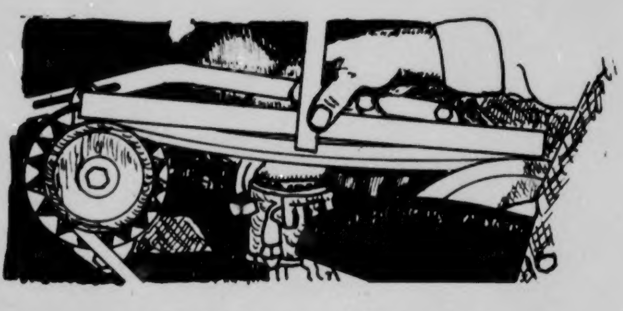


F. If there is not a tension gauge available, lay a straightedge lengthwise on the belt.

G. Using a ruler in the middle of the straightedge, push down on the surface of the belt.

H. Read the distance from the belt to the straightedge.

(NOTE: The reading should not exceed 1/2 inch to 5/8 inch.)



I. Correct all belt tension.

J. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

JOB SHEET #10--TEST, REMOVE, AND REPLACE FAN CLUTCH

I. Tools

A. 7/16" x 1/2" open-end wrench

B. Shop towel

C. Fender cover

II. Procedure

(NOTE: Follow all safety rules.)

A. Place transmission in neutral and set parking brake.

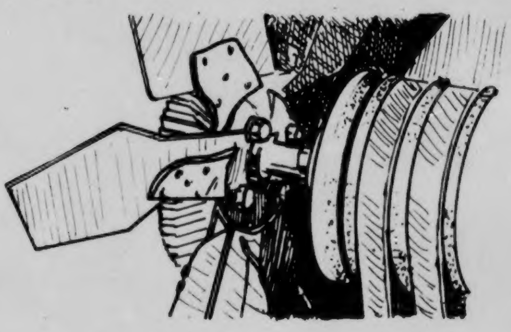
B. Raise the car hood and put on the fender cover.

C. Put a shop towel on the blade of the fan and attempt to turn the fan opposite from the direction of rotation.

(NOTE: If the fan is hard to turn, the fan clutch is all right.)

D. If the fan turns easily, remove the fan clutch.

E. Using a 7/16" x 1/2" wrench, remove the four mount bolts at the rear of the clutch.



F. Remove the clutch and fan.

(NOTE: Use car so you will not damage the radiator when removing the fan.)

G. Place a good fan clutch on the fan.

H. Align the clutch and fan, with the holes toward the engine.

I. Install the four mount bolts and tighten securely.

J. Check with the instructor and run the engine.

K. Shut down the engine and check the new fan clutch.

L. Close the car hood.

M. Clean the work area and turn in tools.

UNIT VIII

ENGINE COOLING SYSTEM

TEST

1. Explain the purpose of the cooling system.

2. Point out the three functions of the cooling system by answering yes or no to each of the following statements.

_____a. Brings coolant and engine up to operating temperature quickly.

_____b. Stores heat to fire the fuel-air mixture in the cylinders.

_____c. Keeps coolant and engine at an even temperature.

_____d. Cools exhaust system.

_____e. Removes unwanted heat.

3. Match the terms with the definitions associated with the cooling system.

_____a. A square unit located in front of the engine, filled with coolant, from which heat generated in the engine leaves the system

_____b. A unit designed to move coolant through the cooling system

_____c. A unit located in the engine head outlet that controls engine coolant temperature

_____d. Connects radiator to the engine and water pump

1. Belt
2. Fan
3. Water pump
4. Fan clutch
5. Anti-freeze
6. Radiator
7. Hoses
8. Thermostat
9. Radiator cap

_____e. Seals the radiator and allows the system to operate under pressure

_____f. A liquid made of ethylene glycol that prevents the coolant from freezing, and which aids in overheating problems

_____g. A unit located to the rear of the radiator that is driven by belts from the crankshaft and pulls air through the radiator

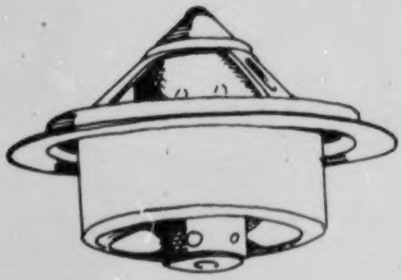
_____h. A device mounted on the fan hub that allows the fan to cut out at speeds over 50 miles

_____i. A flexible rubber and steel strap used to drive the water pump from the crankshaft by pulleys

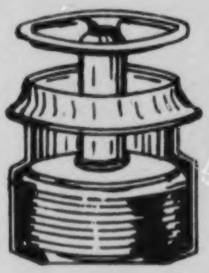
1. Belt
2. Fan
3. Water pump
4. Fan clutch
5. Anti-freeze
6. Radiator
7. Hoses
8. Thermostat
9. Radiator cap

4. Select the correct type of thermostat by labeling each of the illustrations with either bellows or pellet.

a.



b.



5. Point out the types and uses of anti-freeze by underlining the correct answer for each of the following questions.

   a. The two types of anti-freeze are (permanent, replaceable) ethylene glycol and (permanent, replaceable) alcohol anti-freeze.

   b. Anti-freeze has a much (higher, lower) freezing point than water.

   c. The (ethylene glycol, alcohol) type prevents boil-over during hot weather.

   d. It is (poisonous, non-poisonous) if swallowed.

   e. The useful life of most anti-freeze is (24 months, 24 years.)

   f. It (will, will not) remove paint from car bodies.

6. Demonstrate the ability to:

   a. Replace the radiator.

   b. Pressure check the radiator.

   c. Pressure check the radiator cap.

   d. Remove and replace the water pump.

   e. Inspect the water pump.

   f. Remove and replace the thermostat.

   g. Test the thermostat for operation off the car.

   h. Remove, inspect, and replace the hoses.

   i. Inspect the fan belts and set the tension.

   j. Test, remove, and replace the fan clutch.

   (NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT VIII

ENGINE COOLING SYSTEM

ANSWERS TO TEST

1. The purpose of the cooling system is to relieve heat generated by explosion in the engine by transferring the heat to the water in the water jackets running through the block, and then transporting it through the hoses to the radiator where it leaves the system by air being drawn through the radiator by the fan.

2. _yes_ a.

   _no_ b.

   yes c.

   _no_ d.

   yes e.

3. _6_ a.

   _3_ b.

   _8_ c.

   _7_ d.

   _9_ e.

   _5_ f.

   _2_ g.

   _4_ h.

   _1_ i.

4. a. pellet

   b. bellows

5. a. permanent, replaceable

   b. lower

   c. ethylene glycol

d. poisonous

e. 24 months

f. will

6. Evaluated to the satisfaction of the instructor.

UNIT IX

EXHAUST SYSTEM

UNIT OBJECTIVE

After completion of this unit, the student will be able to identify, service, and replace components of the exhaust system. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the exhaust system.
2. Match the terms and definitions associated with the exhaust system.
3. Point out the route of exhaust gases from the time they are created to when they are discharged to the air.
4. Select the correct exhaust system tools and materials for each of the jobs associated with exhaust system repair.
5. Demonstrate the ability to:
    a. Change a tail pipe.
    b. Change mufflers.
    c. Service the heat-control valve.

UNIT IX

EXHAUST SYSTEM

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies

   D. Discuss unit and specific objectives.

   E. Discuss information and job sheets.

   F. Demonstrate the procedures outlined on the job sheets.

   G. Give test.

II. Students

   A. Read objectives.

   B. Study information sheet.

   C. Complete each job sheet.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM-1--Exhaust System Tools

      2. TM-2--Exhaust Systems

      3. TM-3--Heat Control Valve

D. Job sheets

  1. Job Sheet #1--Change a Tail Pipe

  2. Job Sheet #2--Change Mufflers

  3. Job Sheet #3--Service the Heat-Control Valve

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: The Goodheart-Wilcox Company, Inc. 1975.

B. Stockel, Martin W. Auto Mechanics Fundamentals. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1974.

UNIT IX

EXHAUST SYSTEM

INFORMATION SHEET

I. The purpose of the exhaust system is to transfer the burned gases from the combustion chamber to the atmosphere and reduce the exhaust noise to an acceptable level.

II. Terms and definitions

A. Exhaust manifold--The collecting point of the burned gases as they leave the engine cylinders

B. Exhaust pipe--Pipe that carries the gases to the muffler

C. Muffler--A device that silences the exhaust noises and routes the burned gases into the tail pipe

D. Resonator--A device in addition to the muffler to further dampen the exhaust pulsations

E. Back pressure--A building up of exhaust gases because the muffler does not allow the burned gases to freely pass through

F. Carbon monoxide--A poisonous gas within the exhaust gases

III. The route of exhaust gases

A. Exhaust gases are created by partial burning of the fuel-air mixture in the cylinders.

B. Exhaust gases leave the cylinders through the valve port.

C. After the gases leave the valve port, they collect in the exhaust manifold.

D. The gases pass through a heat-control valve into the exhaust pipe.

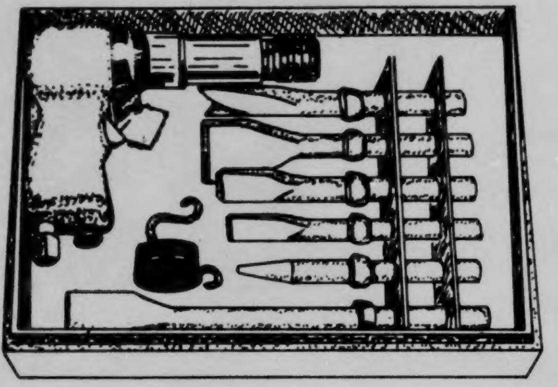
(NOTE: Some vehicles will have a resonator at this point in the exhaust pipe.)

E. The exhaust pipe transfers the gases to the muffler, where they are discharged to the atmosphere through a tail pipe.

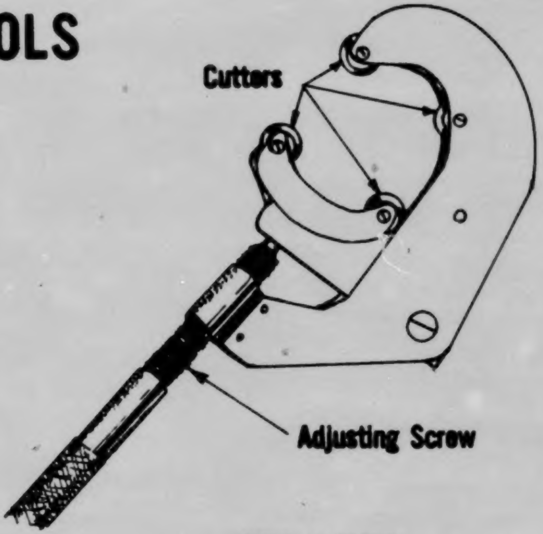
IV. Exhaust system tools and materials

- A. Power chisel--Used in cutting welded mufflers free and in removing tail and exhaust pipes
- B. Hand-operated pipe cutter--Used for cutting pipes smoothly
- C. Electric pipe joint heater--Used in heating pipe joints to loosen the connection
- D. Pipe expanding tool--Used to expand pipe ends for better joint fits
- E. Pipe end-straightening cone--Used to straighten crimped or distorted pipe ends
- F. Chain wrench--Provides a good grip on pipe to help in pipe alignment or removal
- G. Exhaust system sealer--Allows the joints to slide together easier, assists in alignment, and prevents exhaust leaks
- H. Penetrating oil--Helps in loosening fasteners and clamps

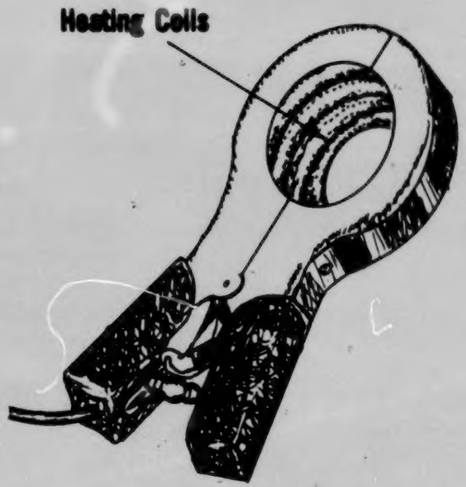
EXHAUST SYSTEM TOOLS



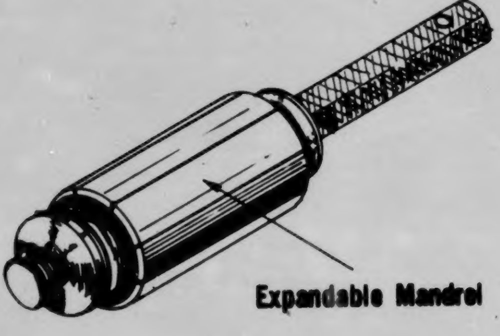
POWER CHISEL


Cutters
Adjusting Screw

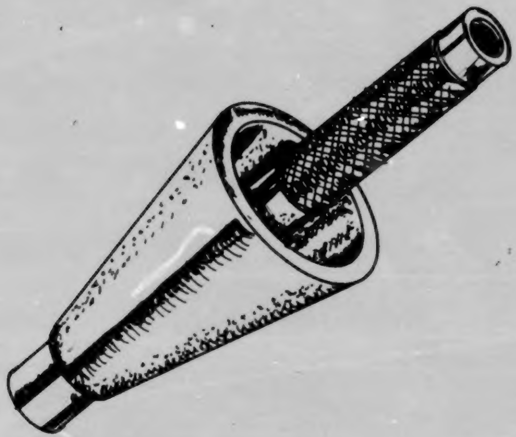
PIPE CUTTER


Heating Coils

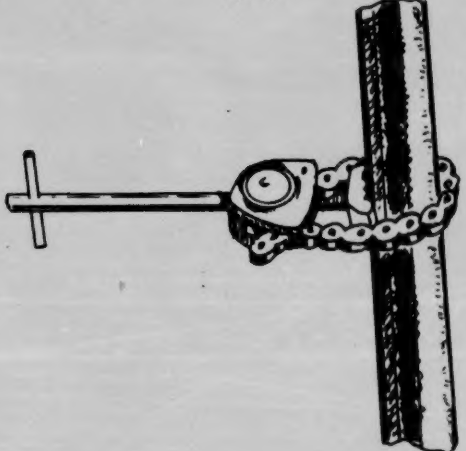
ELEC. PIPE JOINT HEATER


Expandable Mandrel

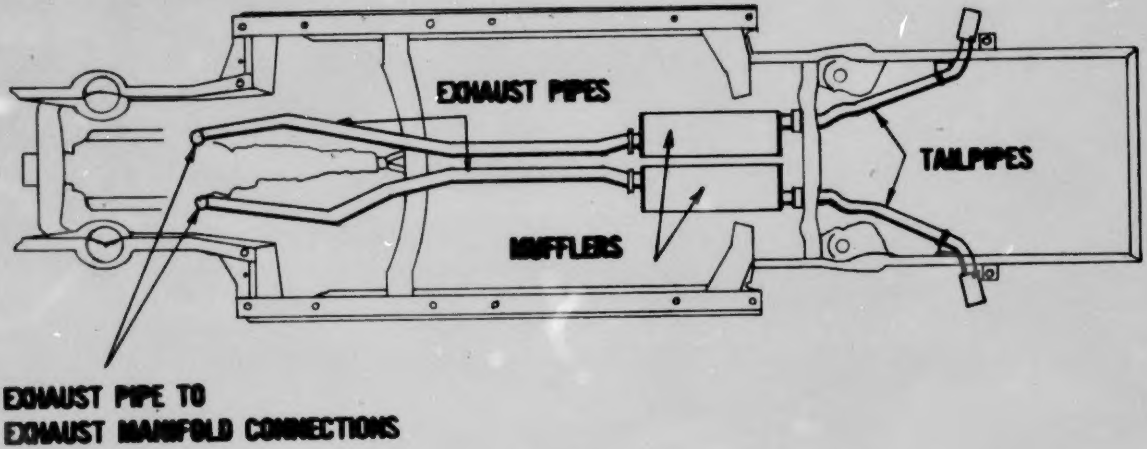
PIPE EXPANDING TOOL



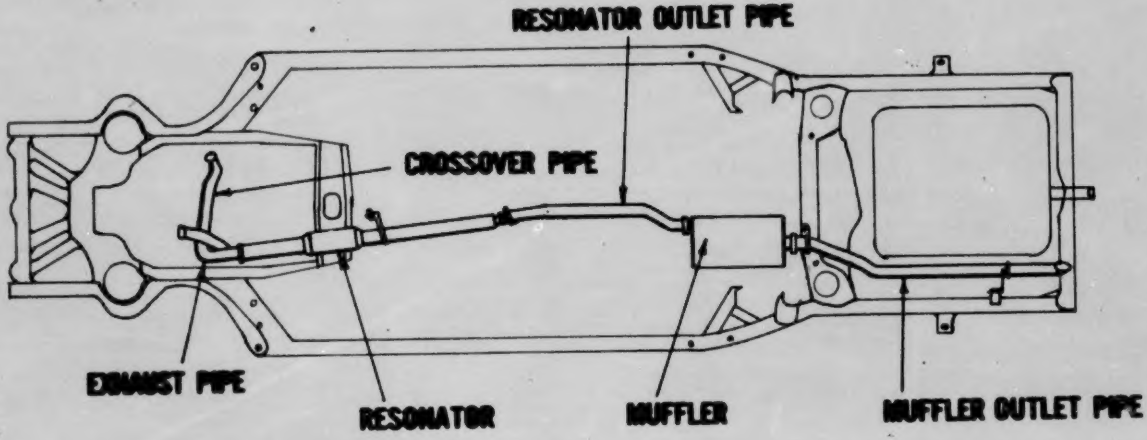
PIPE END STRAIGHTENING CONE



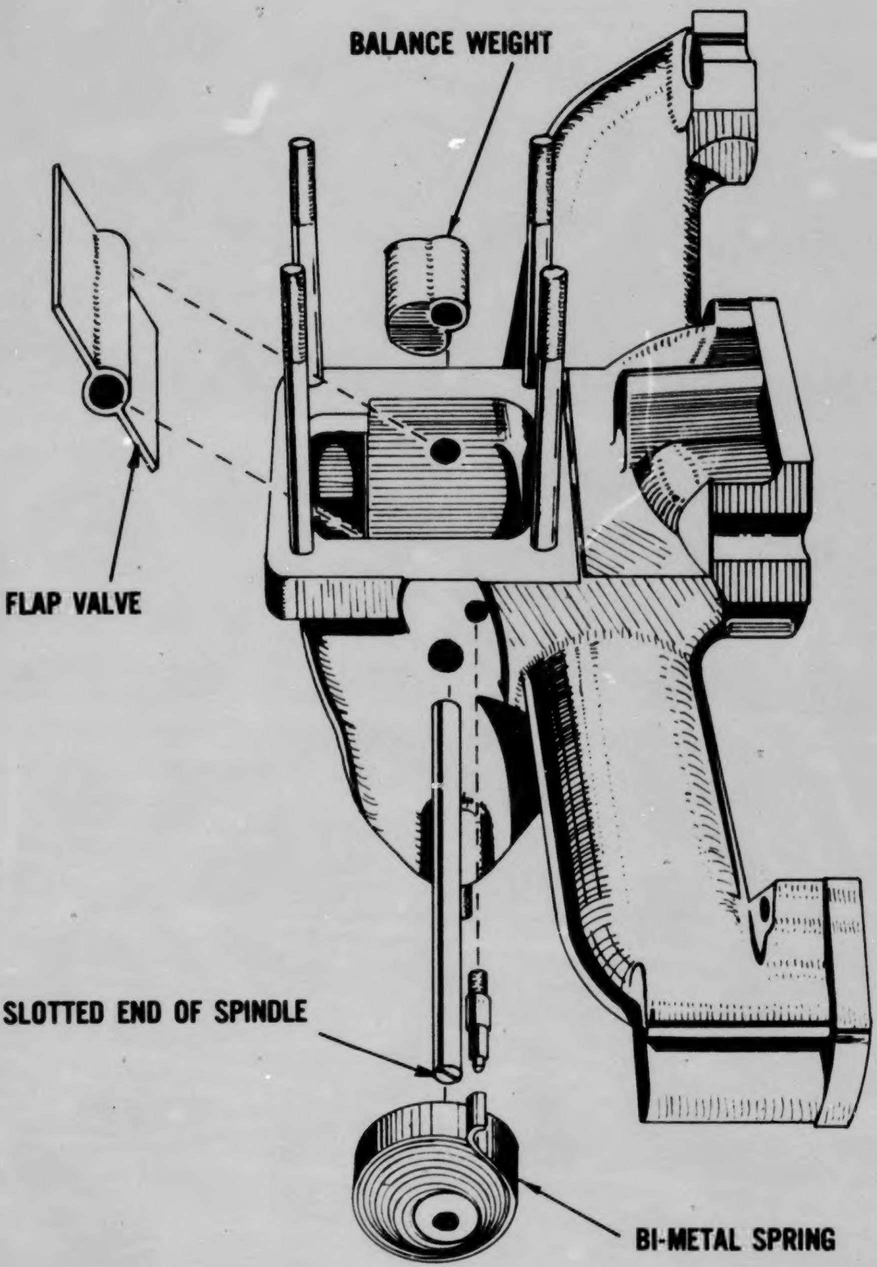
CHAIN WRENCH


EXHAUST PIPES
TAILPIPES
MUFFLERS
EXHAUST PIPE TO
EXHAUST MANIFOLD CONNECTIONS

EXHAUST SYSTEM COMPONENTS


RESONATOR OUTLET PIPE
CROSSOVER PIPE
EXHAUST PIPE
RESONATOR
MUFFLER
MUFFLER OUTLET PIPE

HEAT CONTROL VALVE


BALANCE WEIGHT
FLAP VALVE
SLOTTED END OF SPINDLE
BI-METAL SPRING

UNIT IX

EXHAUST SYSTEM

JOB SHEET #1--CHANGE A TAIL PIPE

I. Tools and materials required

- A. Power chisel
- B. Box-end wrench set
- C. Oxyacetylene torch
- D. Hydraulic jack
- E. Jack stands
- F. Exhaust system sealer
- G. Wire brush
- H. File

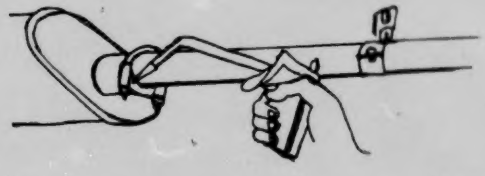
II. Procedure

(NOTE: Follow all safety rules.)

A. Raise the car enough to place jack stands.

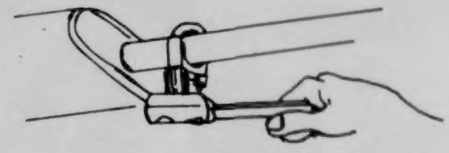
B. Place jack stands under frame of car.

C. Use penetrating oil on nuts and bolts of clamps, fasteners, and brackets.



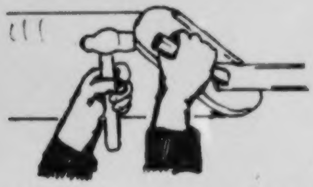
D. Remove all clamps and brackets holding tailpipe in place.

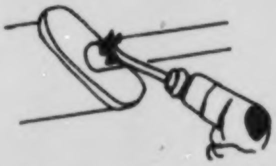
(NOTE: If the penetrating oil does not loosen the nuts on the clamps and brackets, warm the nuts with the torch.)



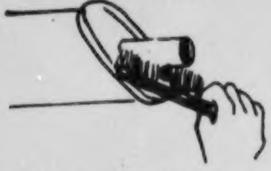
E. Remove tail pipe.

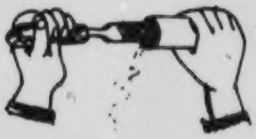
(NOTE: If the pipe is stuck, use the power chisel to loosen the joint.)





F. Clean the end of the muffler nipple with a wire brush or file.





G. Apply a heavy coating of exhaust system sealer to the end of the tail pipe and the muffler nipple.

H. Install the tail pipe.

I. Align the tail pipe and tighten the clamps and brackets.

J. Remove the jack stands and lower the car.

K. Place transmission in neutral and secure parking brake.

L. Start the engine and check for exhaust leaks.

M. Shut off engine.

N. Clean work area and turn in tools.

UNIT IX

EXHAUST SYSTEM

JOB SHEET #2--CHANGE MUFFLERS

I. Tools

A. Power chisel

B. Box-end wrench set

C. Oxyacetylene torch

D. Hydraulic jack

E. Jack stands

F. Wire brush

G. File

H. Exhaust system sealer

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise the car enough to place jack stands.

B. Place jack stands under frame of car.

C. Use penetrating oil on nuts and bolts of clamps and fasteners.

D. Remove tail pipe.

(NOTE: Follow procedure in Job Sheet #1.)

E. Remove pipe clamp between the exhaust pipe and muffler.

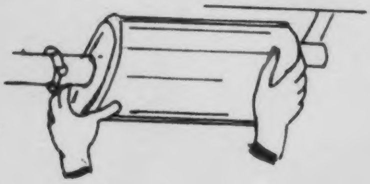
F. Remove the muffler.

(NOTE: Heating or splitting the muffler with a power chisel may be necessary.)

G. Straighten the end of the exhaust pipe.

H. Clean the end of the exhaust pipe and apply exhaust sealer.

I. Slide the new muffler inlet nipple onto the exhaust pipe.



J. Align the muffler and install the pipe clamp.

(NOTE: If pipe clamps or brackets are badly rusted, replace them.)

K. Install the tail pipe.

L. Align the tail pipe and tighten clamps and brackets.

M. Remove jack stands and lower the car.

N. Place transmission in neutral and secure parking brake.

O. Start the engine and check for exhaust leaks.

P. Shut off engine.

Q. Clean work area and turn in tools.

UNIT IX

EXHAUST SYSTEM

JOB SHEET #3--SERVICE THE HEAT-CONTROL VALVE

I. Tools and materials required

   A. Carburetor cleaner

   B. Graphite

   C. Pliers

II. Procedure

   (NOTE: Follow all safety rules.)

   A. Apply carburetor cleaner to ends of spring shaft.

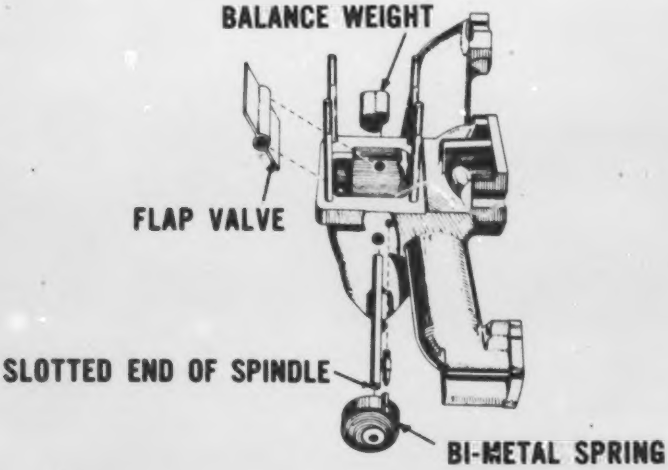
   B. Place transmission in neutral and secure parking brake.

   C. Start engine and allow to warm to normal operating temperature.

   D. Shut off engine.

   E. Free the valve if it is sticking.

      (CAUTION: The exhaust system will be hot, so use the necessary tools to free the valve.)


BALANCE WEIGHT
FLAP VALVE
SLOTTED END OF SPINDLE
BI-METAL SPRING

F. Lubricate the shaft with graphite.

(NOTE: The exhaust pipe may be removed to free or lubricate the valve if necessary.)

G. Install the exhaust pipe to the manifold if it was removed.

H. Clean work area and turn in tools.

UNIT IX

EXHAUST SYSTEM

TEST

1. Explain the purpose of the exhaust system.

2. Match the terms and definitions associated with the exhaust system.

_____a. The collecting point of the burned gases as they leave the engine cylinders

_____b. Pipe that carries the gases to the muffler

_____c. A device that silences the exhaust noises and routes the burned gases into the tail pipe

_____d. A device used in addition to the muffler to further dampen exhaust pulsations

_____e. A building up of exhaust gases because the muffler does not allow the burned gases to freely pass through

_____f. A poisonous gas within the exhaust gases

1. Muffler
2. Carbon Monoxide
3. Brake pressure
4. Exhaust manifold
5. Exhaust pipe
6. Resonator

3. Point out the route of the exhaust gases from the time they are created to when they are discharged to the air by numbering the order of the following events.

_____a. The gases pass through a heat-control valve into the exhaust pipe.

_____b. After they leave the valve ports they collect in the exhaust manifold.

_____c. Exhaust gases are created by the partial burning of the fuel-air mixture in the cylinders.

_____d. The exhaust pipe tranfers the gases to the muffler where they are discharged to the atmosphere through a tailpipe.

_____e. Exhaust gases leave the cylinders through the valve port.

4. Select the correct exhaust system tools and materials for each of the jobs associated with exhaust system repair.

_____a. Used in cutting welded mufflers free and in removing tail and exhaust pipes

_____b. Used for cutting pipes smoothly

_____c. Used in heating pipe joints to loosen the connection

_____d. Used to expand ends for a joint, or to better joint fits

_____e. Used to straighten crimped or distorted pipe ends

_____f. Provides a good grip on pipe to help in pipe alignment or removal

_____g. Allows the joints to slide together easier, assists in alignment, and prevents exhaust leaks

_____h. Helps in loosening fasteners and clamps

1. Pipe and straightening cone
2. Power chisel
3. Electric pipe joint heater
4. Penetrating oil
5. Chain wrench
6. Pipe expanding tool
7. Hand-operated pipe cutter
8. Exhaust system sealer

5. Demonstrate the ability to:
   a. Change a tail pipe.
   b. Change mufflers.
   c. Service the heat-control valve.

   (NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT IX

EXHAUST SYSTEM

ANSWERS TO TEST

1. The purpose of the exhaust system is to transfer the burned gases from the combustion chamber to the atmosphere and reduce the exhaust noise to an acceptable level.

2. __4__ a.

   __5__ b.

   __1__ c.

   __6__ d.

   __3__ e.

   __2__ f.

3. __4__ a.

   __3__ b.

   __1__ c.

   __5__ d.

   __2__ e.

4. __2__ a.

   __7__ b.

   __3__ c.

   __6__ d.

   __1__ e.

   __5__ f.

   __8__ g.

   __4__ h.

5. Evaluated to the satisfaction of the instructor.

UNIT X

WHEELS, BEARINGS, AND TIRES

UNIT OBJECTIVE

After completion of this unit, the student will be able to discuss the care and handling of wheels, bearings, and tires. The student will be able to inspect, test, and service wheels, bearings, and tires. This will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with wheels, bearings, and tires.
2. Select the proper safety rules associated with wheels, bearings, and tires.
3. List five faults you may find when inspecting a damaged wheel.
4. Determine the causes of improper tire wear.
5. Name the two methods of repairing a punctured tire.
6. Explain the purpose of rotating tires.
7. Demonstrate the ability to:
    a. Inspect a wheel for damage.
    b. Remove and install a wheel.
    c. Remove wheel bearings.
    d. Clean, inspect, and pack wheel bearings.
    e. Install wheel bearings.
    f. Remove a tire from a rim.
    g. Install a tire on a rim.
    h. Repair a punctured tire.

i. Balance a wheel and tire.

J. Rotate the tires, including the spare.

UNIT X

WHEELS, BEARINGS, AND TIRES

SUGGESTED ACTIVITIES

I. Instructor

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Make transparencies.

  D. Discuss unit and specific objectives.

  E. Discuss information sheets.

  F. Demonstrate and discuss procedures outlined in job sheets.

  G. Give test.

II. Student

  A. Read objective sheet.

  B. Study and discuss information sheets.

  C. Demonstrate ability to accomplish the procedures outlined in the job sheets.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM-1--Wheel Damage

    2. TM-2--Wheel Assembly

    3. TM-3--Wheel Bearing Assembly

4. TM-4--Cleaning, Inspecting, and Packing Wheel Bearing
5. TM-5--Tire Changing Equipment
6. TM-6--Repairing a Punctured Tire
7. TM-7--Balancing Tire and Wheel
8. TM-8--Tire Rotation

D. Job sheets

1. Job Sheet #1--Remove and Install A Wheel
2. Job Sheet #2--Inspect A Wheel for Damage
3. Job Sheet #3--Remove Wheel Bearings
4. Job Sheet #4--Clean, Inspect, and Pack Bearings
5. Job Sheet #5--Install Wheel Bearings
6. Job Sheet #6--Remove Tire from Rim
7. Job Sheet #7--Install Tire on Rim
8. Job Sheet #8--Repair a Punctured Tire
9. Job Sheet #9--Balance Wheel and Tire
10. Job Sheet #10--Rotate Tires, Including Spare

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1975.

B. Staff. Chilton Auto Repair Manual. Radnor, Pennsylvania: Chilton Book Company, 1973.

UNIT X

WHEELS, BEARINGS, AND TIRES

INFORMATION SHEET

I. Definition of terms

- A. Ball bearing--An inner and outer race separated by steel balls.
- B. Mag wheel--A wheel made of magnesium, usually lightweight, sporty and comes in many sizes
- C. Race--Inner or outer ring for ball bearings to run on
- D. Safety rim--Rim having two safety ridges to prevent the tire form leaving the rim in the event of a blowout
- E. Sealed bearing--Bearing that has been lubricated at the factory and sealed; cannot be relubricated
- F. Slicks--A wide, smooth tire, providing maximum traction
- G. Static balance--Even distribution of weight around the axis of rotation
- H. Dynamic balance--Even distribution of weight to each side of the tire and rim
- I. Tapered roller bearing--Bearing with tapered steel rollers between an inner and outer race
- J. Tire balance--Tires balanced for both static and dynamic balance
- K. Tire sidewall--Part of tire between tread and bead
- L. Tire tread--Part of tire that contacts road
- M. Tramp--Front tire hopping up and down
- N. Lug bolt and nut--Fasteners that hold the wheel to the hub
- O. Wheel balancer--Machine on which to balance wheels

II. Safety rules

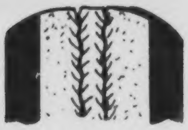
- A. Always use jack stands when car is lifted.
- B. Place jacks and stands in a secure position.
- C. Tighten lug nuts securely.
- D. Replace tires before they become slick.
- E. Keep front end aligned.
- F. Rotate tires at proper intervals (5,000 miles.).
- G. Use extreme care when inflating tire.
- H. Keep hands and fingers from between bead and flange when inflating tire.
- I. Observe tire wear patterns.
- J. Inflate tires to correct pressure.
- K. Use a lubricant when mounting tires.
- L. Use new cotter pin in hub nut.
- M. Tighten hub nuts properly.
- N. When packing wheels with grease, always replace a bearing in the same wheel from which it was removed.
- O. Remember hand-tool safety rules.

III. Faults found in a damaged wheel

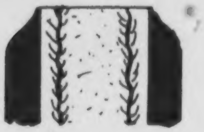
- A. Dents
- B. Cracks
- C. Excessive wear in bolt holes
- D. Burrs
- E. Warpage

IV. Causes of improper tire wear

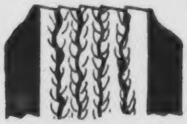
A. Under-inflation



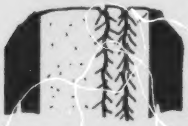
B. Over-inflation



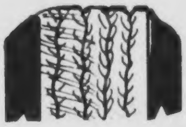
C. Incorrect toe-in or toe-out adjustment



D. Incorrect camber adjustment



E. Excessive cornering speed



V. Two methods of repairing a punctured tire

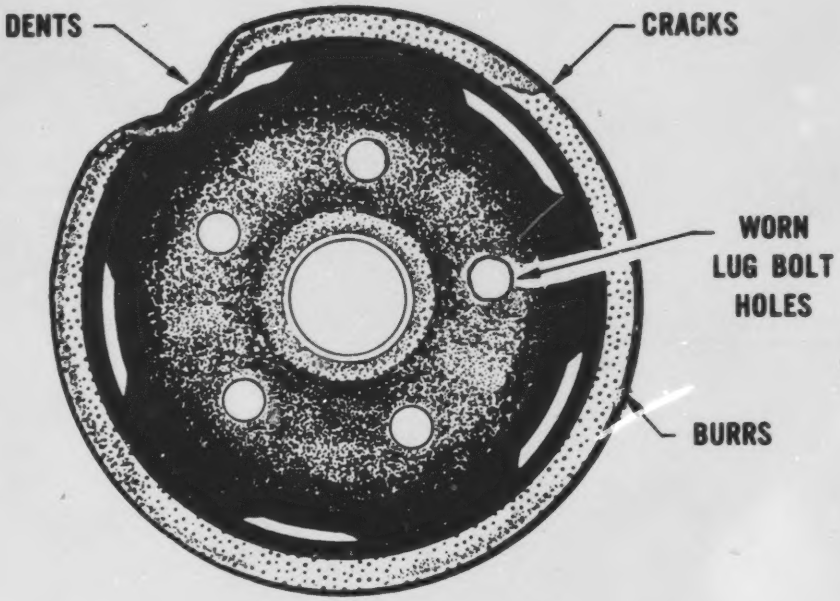
A. Plug

B. Patch

VI. Purpose of rotating tires

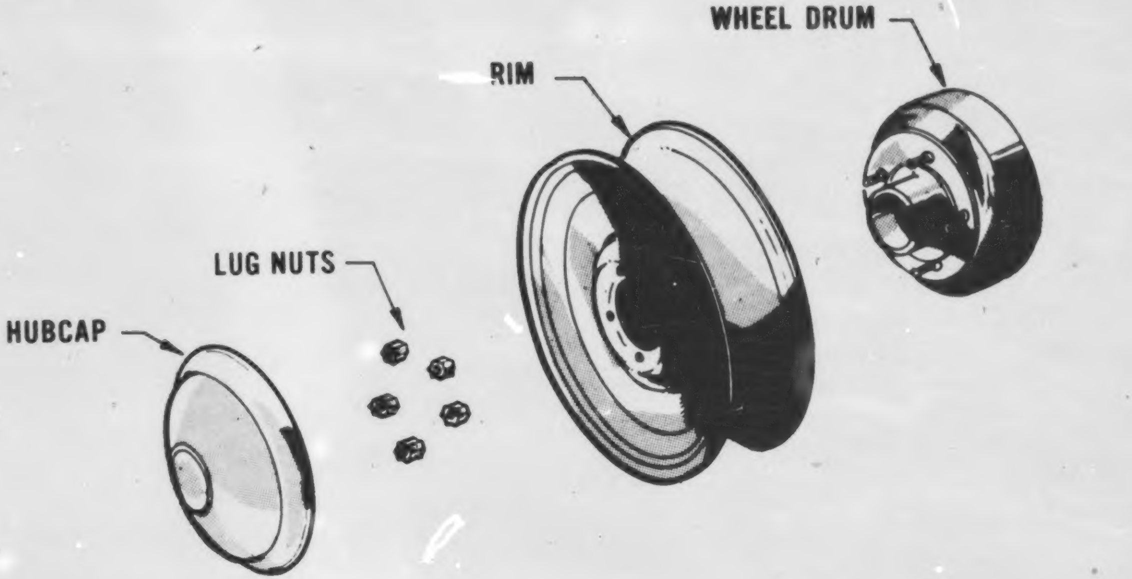
To make the set of tires wear evenly

WHEEL DAMAGE

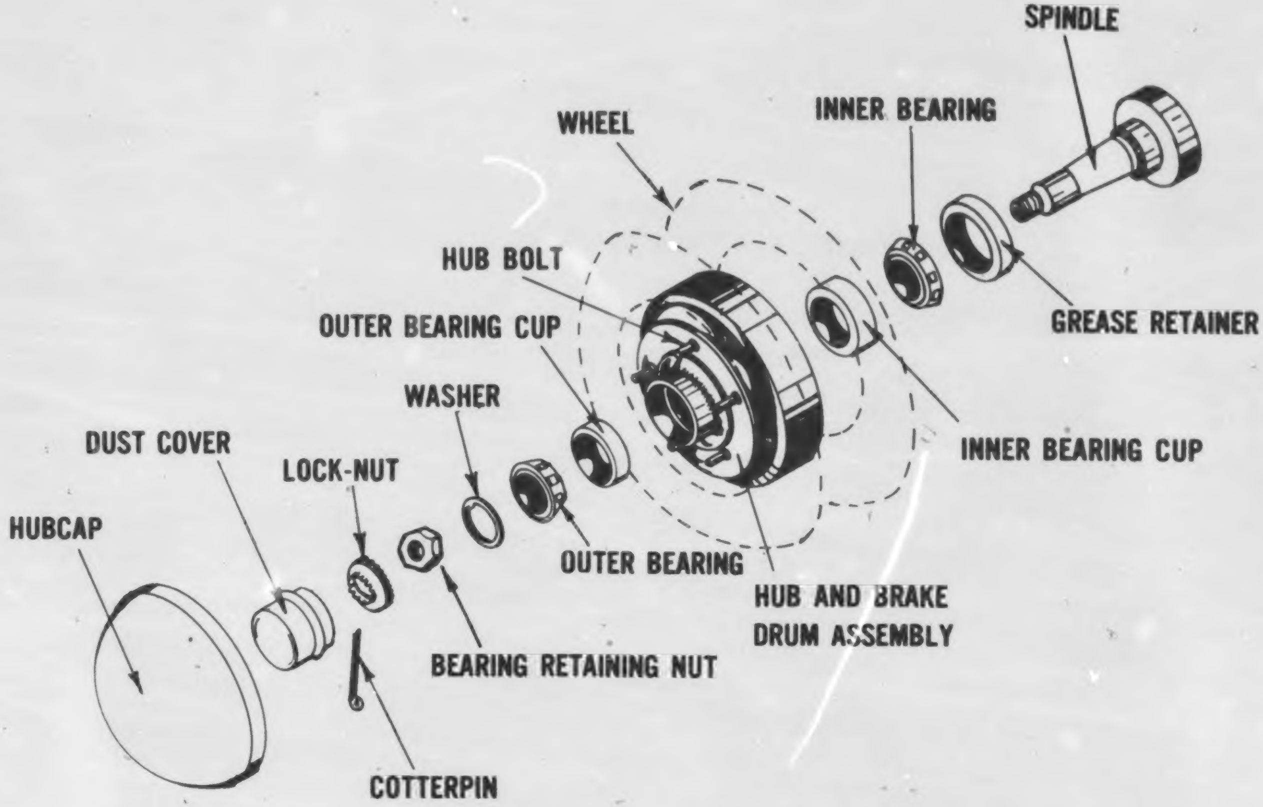

DENTS
CRACKS
WORN
LUG BOLT
HOLES
BURRS

338

WHEEL ASSEMBLY

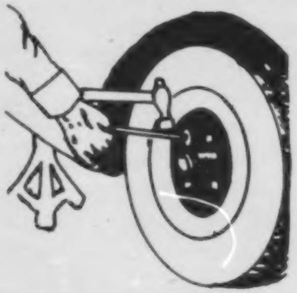

WHEEL DRUM
RIM
LUG NUTS
HUBCAP

WHEEL BEARING ASSEMBLY

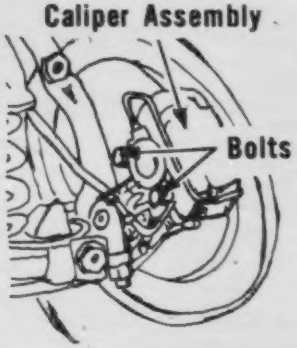

SPINDLE
INNER BEARING
WHEEL
HUB BOLT
GREASE RETAINER
OUTER BEARING CUP
WASHER
INNER BEARING CUP
DUST COVER
LOCK-NUT
HUBCAP
OUTER BEARING
HUB AND BRAKE DRUM ASSEMBLY
BEARING RETAINING NUT
COTTERPIN

CLEANING, INSPECTING, AND PACKING WHEEL BEARING

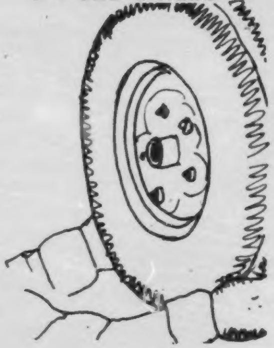
REMOVE DUST CAP



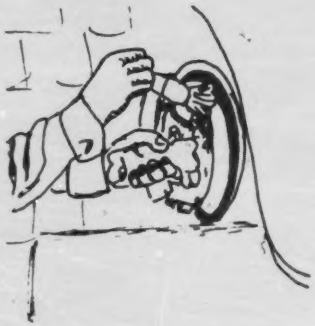
REMOVE BRAKE CALIPER
WHERE USED



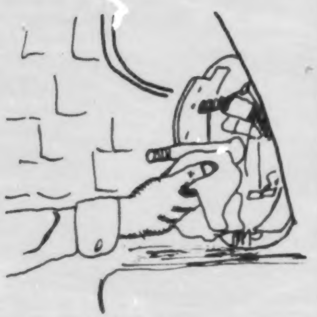
REMOVE COTTER PIN,
ADJUSTING NUT,
& PULL WHEEL

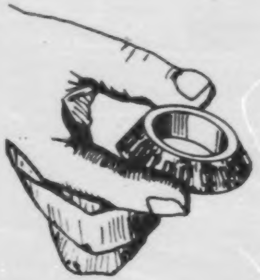


COVER SPINDLE &
CLEAN BREAK ASSEMBLY

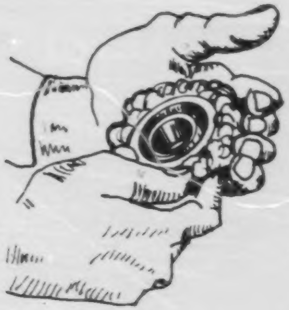


CLEAN, INSPECT,
& LUBE SPINDLE

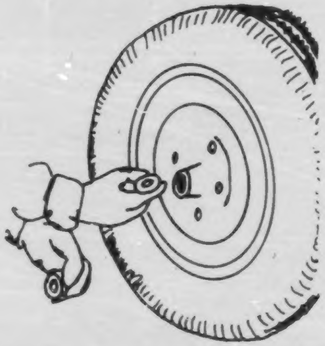




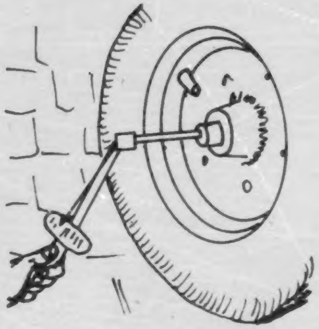
CLEAN & INSPECT
WHEEL BEARINGS



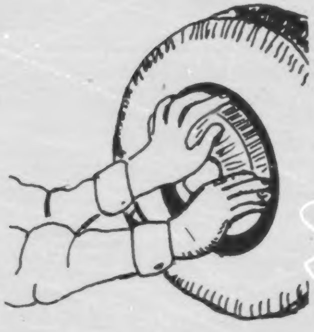
PACK BEARINGS



LUBE HUB, INSTALL BEARINGS,
& GREASE SEAL. INSTALL WHEEL,
OUTER BEARING, SAFETY WASHER,
& ADJUSTING NUT

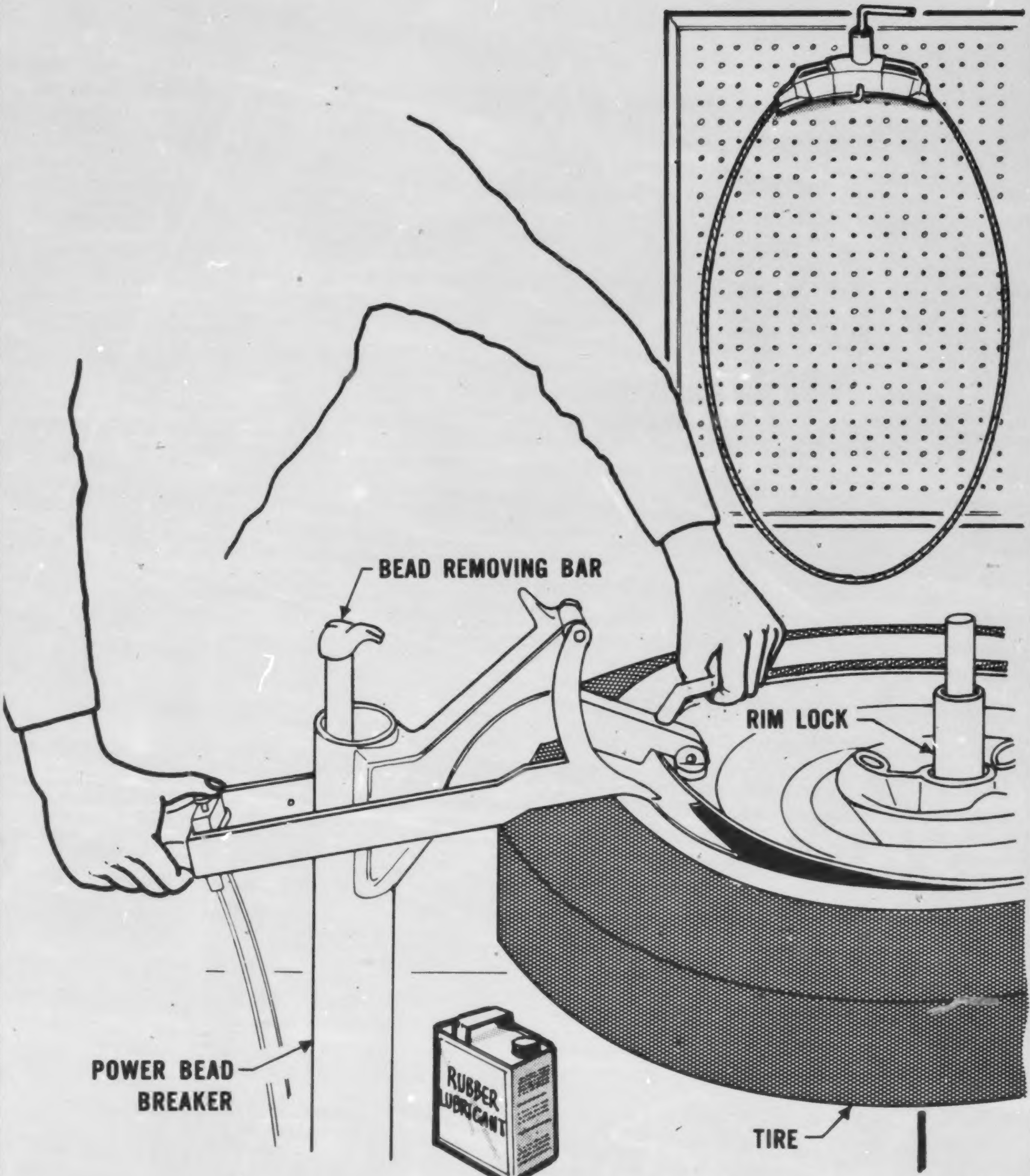


ADJUST BEARINGS,
INSTALL COTTER PINS,
& DUST COVER

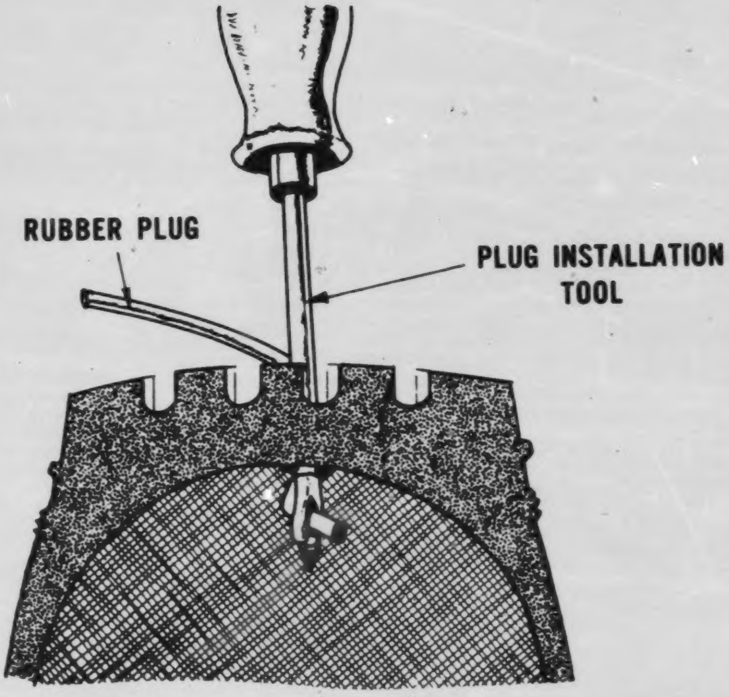


INSTALL WHEEL COVER
OR HUB CAP

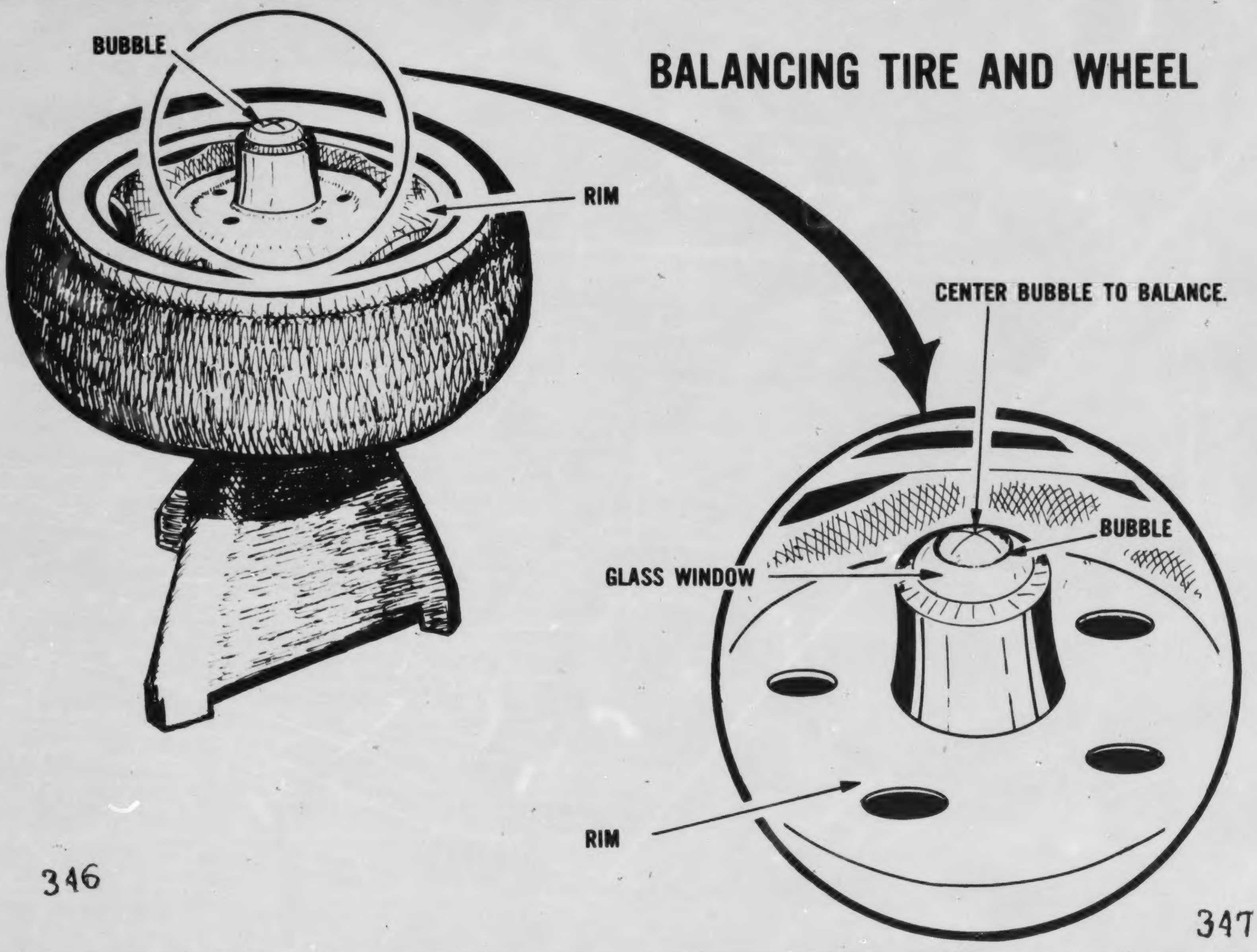
TIRE-CHANGING EQUIPMENT


BEAD REMOVING BAR
RIM LOCK
POWER BEAD BREAKER
RUBBER LUBRICANT
TIRE

REPAIRING A PUNCTURED TIRE


RUBBER PLUG
PLUG INSTALLATION TOOL

BALANCING TIRE AND WHEEL


BUBBLE
RIM
CENTER BUBBLE TO BALANCE.
BUBBLE
GLASS WINDOW
RIM

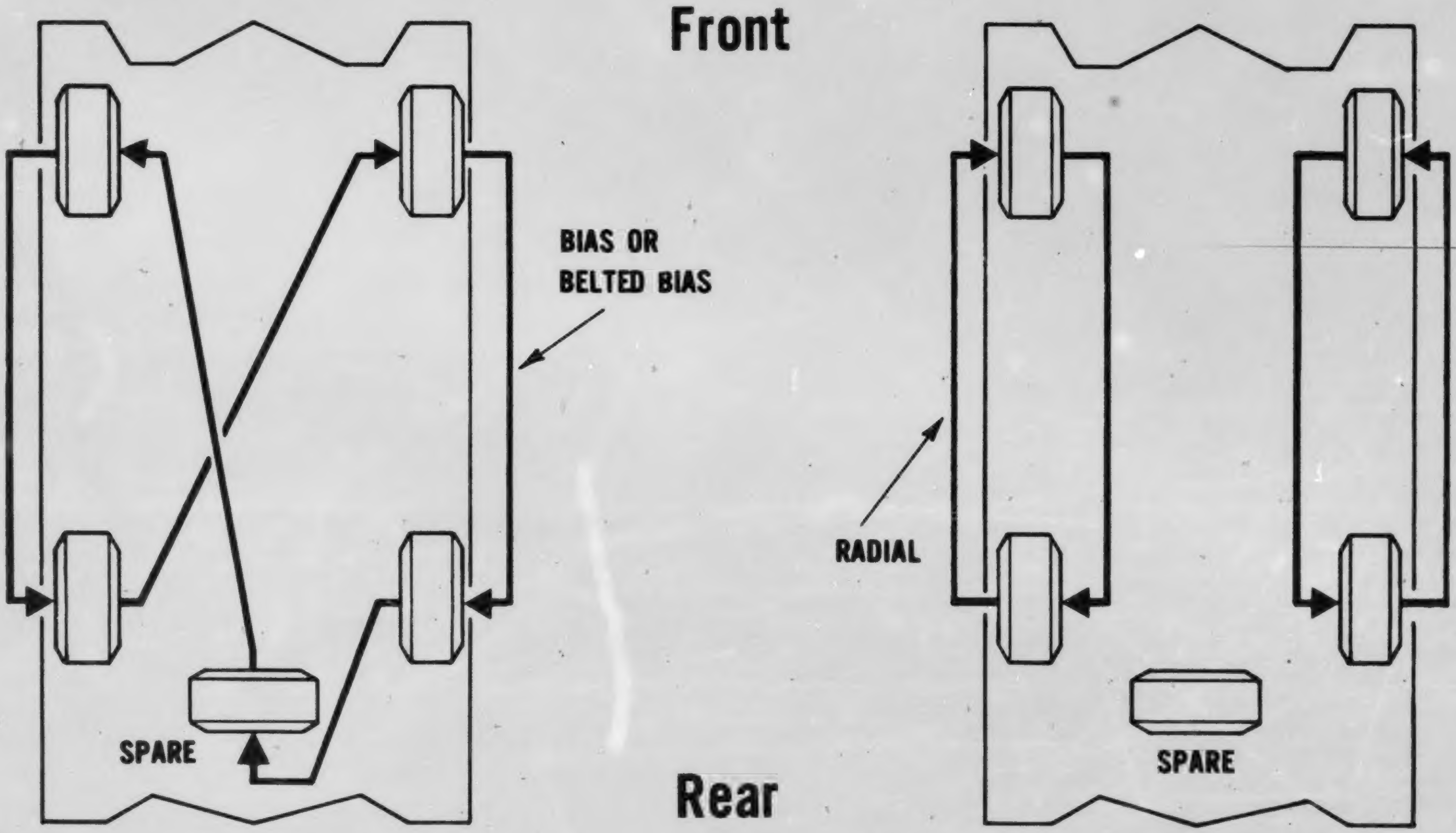
346

347

TM-7

X-21

TIRE ROTATION


Front
BIAS OR BELTED BIAS
SPARE
RADIAL
SPARE
Rear

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #1--REMOVE AND INSTALL A WHEEL

I. Tools, equipment, and materials required

  A. Hydraulic floor jack

  B. Jack stand

  C. Lug wrench as required

  D. Shop rag

  E. Large screwdriver

  F. Rubber mallet

II. Procedure

  (NOTE: Follow all safety rules.)

  A. Set parking brake or chock wheels.

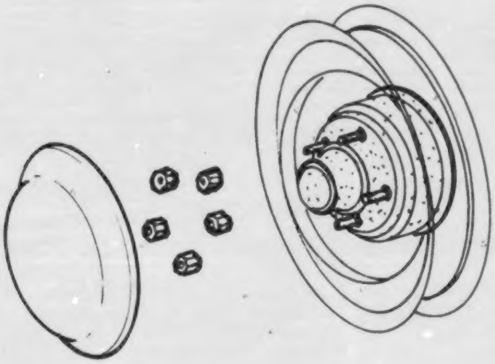
  B. Raise car where wheel is to be removed.

  C. Place jack stand under car in secure location.

  D. Remove hub cap.

  E. Remove lug nuts.

    (NOTE: Place in hub cap.)



F. Remove the wheel.

G. Check the wheel for damage

(NOTE: See Job Sheet #2 for checking procedures.)

H. Install a good wheel.

I. Put on lug nuts and tighten securely.

J. Install hub cap.

(NOTE: Use rubber mallet.)

K. Remove jack stand.

L. Lower car to floor.

M. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #2--INSPECT A WHEEL FOR DAMAGE

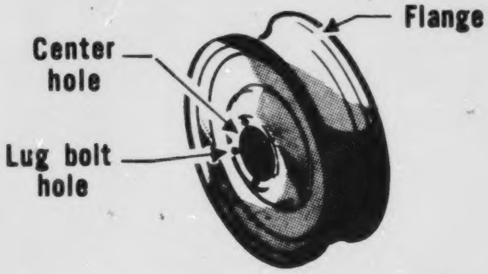
I. Tools, equipment, and materials required

- A. Wire brush
- B. Shop rag
- C. Cleaning vat
- D. Wheel weight tool
- E. Car wheel

II. Procedure

(NOTE: Follow all safety rules.)

- A. Clean wheel with wire brush and cleaning vat.
- B. Remove any wheel weights with the wheel weight tool.
- C. Check the rim for dents, burns, cracks, or any other damage.
- D. Check wheel bolt holes for cracks and excessive wear.
- E. Check flanges for dents and cracks.



- F. Check the center hole for damage.
- G. Report any damage to the instructor.
- H. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #3--REMOVE WHEEL BEARINGS

I. Tools, equipment, and materials required

A. Shop rag

B. Hydraulic floor jack

C. Jack stand

D. Large common screwdriver

E. Pliers

F. 15/16" x 1" box end wrench

G. Hammer

H. Steel bar for a race driver

II. Procedure

(NOTE: Follow all safety rules.)

A. Set parking brake or chock wheels.

B. Raise the car where the wheel is to be removed.

C. Place the jack stand under the car in a secure position.

D. Remove the hub cap.

E. Remove the dust cover.

F. Remove the hub nut cotter pin.

G. Remove the bearing adjustment nut.

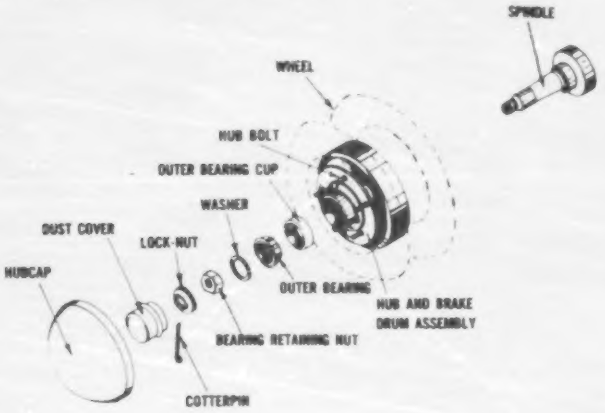
(NOTE: There may be a stamped locknut that has to be removed before the nut can be removed.)

H. Remove the flat washer.

I. Remove the wheel.

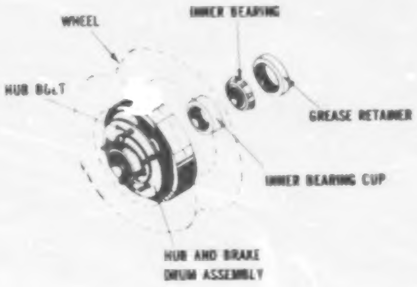
(CAUTION: Protect the spindle threads during wheel removal.)

(NOTE: Vehicles with disc brakes will have a brake caliper that must be removed before the wheel can be removed.)


SPINDLE
WHEEL
HUB BOLT
OUTER BEARING CUP
WASHER
DUST COVER
LOCK-NUT
HUBCAP
OUTER BEARING
HUB AND BRAKE DRUM ASSEMBLY
BEARING RETAINING NUT
COTTERPIN

J. Remove the front wheel bearing.

K. Remove the rear seal and bearing by carefully tapping the edges of the race through the wheel hub with a steel bar and hammer.


WHEEL
INNER BEARING
HUB BOLT
GREASE RETAINER
INNER BEARING CUP
HUB AND BRAKE DRUM ASSEMBLY

L. Place the bearings in a clean container.

M. If bearings are to be packed, go to the procedures outlined in Job Sheet #4.

N. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #4--CLEAN, INSPECT, AND PACK BEARINGS

I. Tools, equipment, and materials required

A. Shop rag

B. Cleaning vat with cleaning fluid

C. Brush

D. Wheel bearing grease

E. Removed wheel bearings

F. Parts tray

II. Procedure

(NOTE: Follow all safety rules.)

A. Wipe excess grease from the bearings.

B. Place bearings and wheel hub parts in a tray.

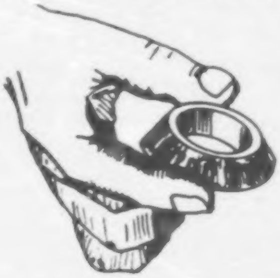
C. Soak parts in the solvent vat.

(CAUTION: Do not use gasoline to clean parts.)

D. Place bearings on a clean rag and allow to dry.

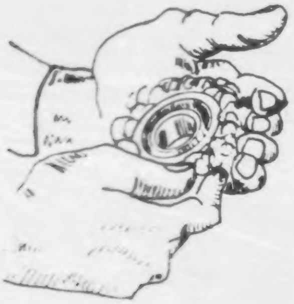
E. Check bearings for cracks, burns, corrosion, dents, and other visible damage.

(NOTE: If a bearing is damaged, it should be replaced.)



F. Place a gob of grease on the palm of one hand.

G. Press the sides of the roller bearings into the grease.



H. Continue this packing process until grease has been forced through the entire bearing.

(NOTE: Protect greased bearing from dust and dirt.)

I. If bearings are ready to be replaced, go on to the procedures outlined in Job Sheet #5.

J. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #5--INSTALL WHEEL BEARINGS

I. Tools, equipment, and materials required

   A. Hydraulic floor jack

   B. Jack stand

   C. Shop rag

   D. Side cutter pliers

   E. 15/16" x 1" box end wrench

   F. Rubber mallet

   G. New cotter pin

   H. Container of solvent

   I. Brush

   J. Steel bar for a race driver

   K. Hammer

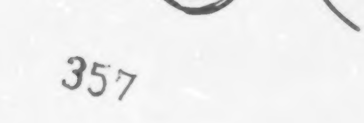
   L. Auto manual

II. Procedure

   (NOTE: Follow all safety rules.)

   A. Clean wheel housing and spindle with a brush and clean solvent.

      (NOTE: Cover the spindle with a rag when brushing the brake assembly.)



B. Wipe clean with a clean rag.

C. Install the rear wheel race with a steel bar and hammer.

(CAUTION: Be careful not to damage the bearing surface of the race.)

D. Place the rear bearing in place.

E. Tap the rear seal gently into place with the rubber mallet.

F. Remove any oil, grease, or solvent from the brake shoes with a clean rag.

G. Slide the wheel hub straight onto the spindle.

(NOTE: Replace the brake caliper if vehicle has dis brakes.)

H. Insert outer bearing race if it was removed.

I. Insert outer bearing.

J. Install thrust washer and nut.

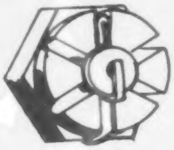
K. Adjust the wheel bearings to manufacturer's specifications.

L. If the auto manual does not specify the adjustment, tighten the nut until the wheel becomes hard to turn and then back the nut off 1/4 turn.

M. Install locknut.

N. Install a new cotter pin.

(NOTE: Make sure the cotter pin is bent over against the spindle and locknut. Clip any excess cotter pin off with the side cutter pliers.)



O. Install the dust cover with the rubber mallet.

P. Install the hub cap with the rubber mallet

Q. Remove the jack stand.

R. Lower the vehicle to the floor.

S. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #6--REMOVE TIRE FROM RIM

I. Tools, equipment, and materials required

A. Tire mounting and demounting equipment

B. Rubber lubricant or soapy water

C. Tire tools necessary for tire equipment

D. Shop rag

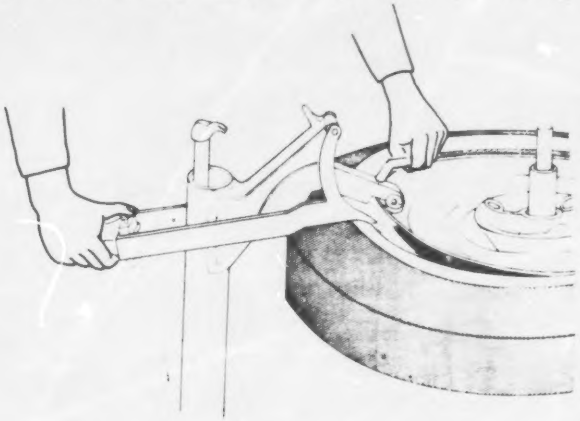
II. Procedures

(NOTE: Follow all safety rules.)

A. Place the wheel on the tire changer.

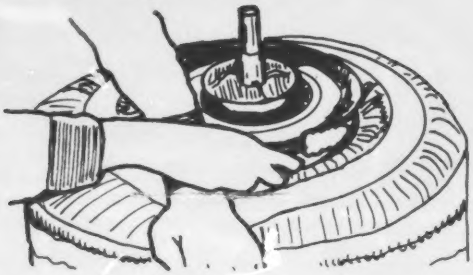
B. Tighten the nut securely.

C. Break the bead down from the sealing surfaces.

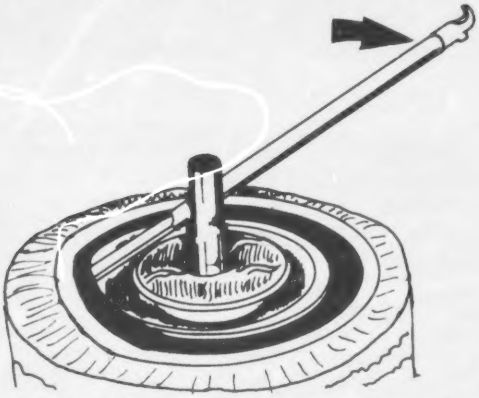


D. If the tire equipment does not bread both beads, turn the tire over and break the bead down.

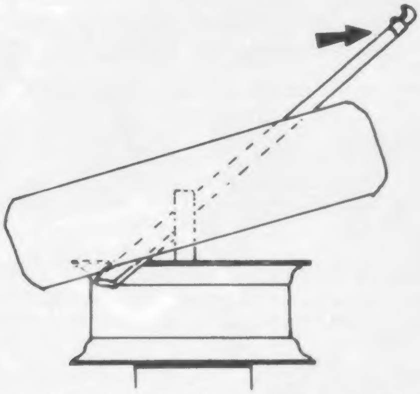
E. Apply rubber lubricant to the beads of the tire and on the rim edge.



F. Using the bead remover bar on the tire equipment, remove the outside bead from the wheel.



G. Remove the inside bead from the wheel.



H. Remove the rim from the tire changer.

I. If a new tire is to be installed, go to the procedures outlined on Job Sheet #7.

J. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #7--INSTALL TIRE ON RIM

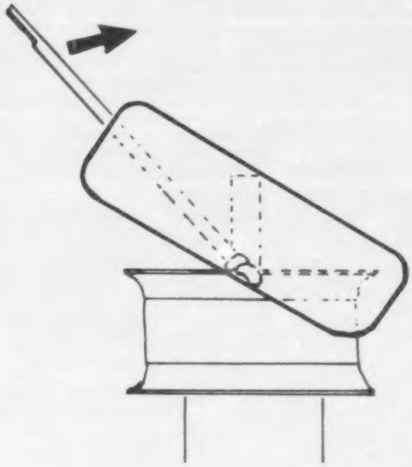
I. Tools, equipment, and materials required

- A. Tire mounting and demounting equipment
- B. Rubber lubricant or soapy water
- C. Tire tools necessary for tire equipment
- D. Shop rag
- E. Bead expander
- F. Tire pressure gauge

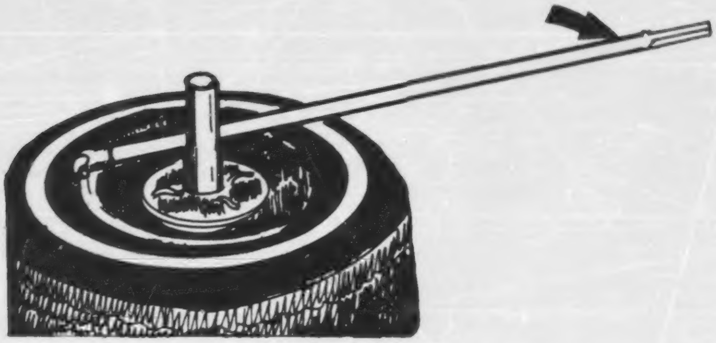
II. Procedure

(NOTE: Follow all safety rules.)

- A. Place rim on tire changer and tighten nut securely.
- B. Clean the rim along the bead-sealing surfaces.
- C. Apply rubber lubricant around the sealing surfaces of the rim.
- D. Lay the tire on the rim.
- E. Install the inner bead on the rim.



F. Install the outer bead on the rim.



G. Loosen the rim hold down nut before inflating the tire.

H. Inflate the tire to the recommended pressure.

(NOTE: If the bead and rim will not seal, use the bead expander to seat the bead only. Remove the bead expander before the pressure reaches 10 pounds.)

I. Remove the tire from the tire changer.

J. Clean the work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #8--REPAIR A PUNCTURED TIRE

I. Tools, equipment, and materials required

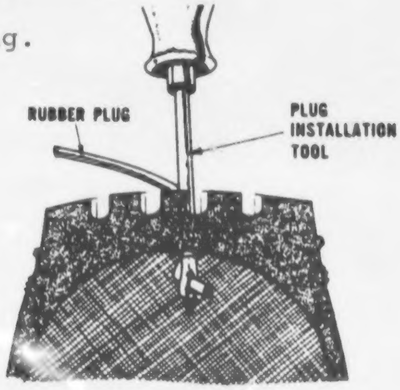
- A. Plug installation tool
- B. Rubber plug or patch
- C. Rubber cement
- D. Scissors
- E. Tire-patching tools
- F. Tire pressure gauge

II. Procedure

(NOTE: Follow all safety rules.)

A. Plug type

1. Remove the object puncturing the tire.
2. Clean out the punctured area.
3. Apply rubber cement to the puncture and the plug.
4. Push the rubber plug through the puncture with the plug-installation tool and then pull it partially back through.
5. Remove the plug installation tool.
6. Cut off the excess plug.



7. Inflate the tire to the correct pressure.

B. Patch type

1. Clean the punctured area inside the tire.

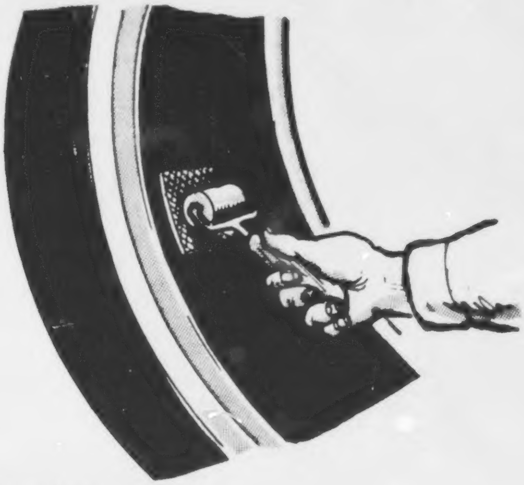
   (NOTE: Refer to Job Sheet #6 for tire removal)

2. Rub the area until it is smooth.

3. Apply rubber cement to the area where the patch will lay.

4. Place the patch over the puncture.

5. Roll it down firmly.



6. Replace tire on rim.

7. Inflate the tire to the correct pressure.

C. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #9--BALANCE A WHEEL AND TIRE

I. Tools, equipment, and materials required

- A. Tire balancer (bubble balancer)
- B. Wheel weights
- C. Wheel weight hammer
- D. Chalk

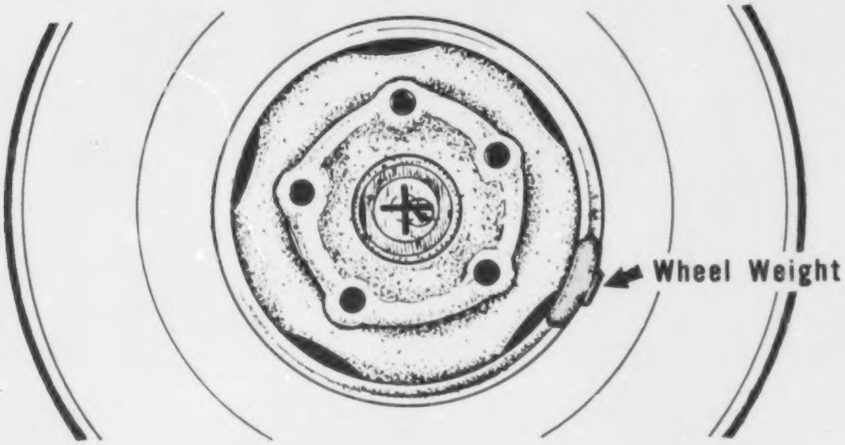
II. Procedure

(NOTE: Follow all safety rules.)

- A. Remove all weights and dirt from the wheel.
- B. Place wheel on balancer.

  (CAUTION: Do not drop the wheel in place.)
- C. Engage the balancer by moving the level to the left.
- D. Observe the position of the bubble.
- E. Place a wheel weight of the approximate size on the wheel flange.

  (NOTE: The weight should be on the same side of the circle as the bubble.)



F. Divide the weights into two weights, if necessary, to balance the tire.

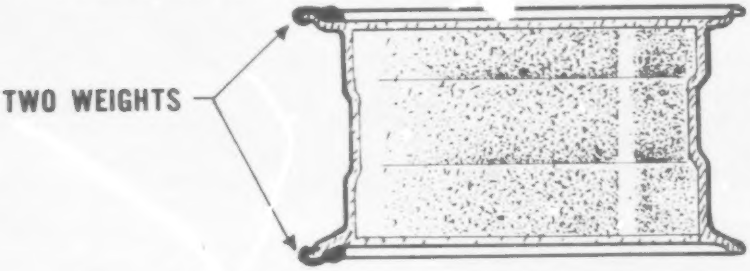
G. Mark across the tread of the tire at each weight.

H. Disengage the balance lever.

I. Remove the wheel from the balancer.

J. Locate two wheel weights which will equal each of the weights required to balance the wheel.

K. Hammer these weights in place on each side of flange in line with the correct mark or marks.



L. Recheck the wheel for proper balance.

M. Clean work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

JOB SHEET #10--ROTATE THE TIRES INCLUDING SPARE

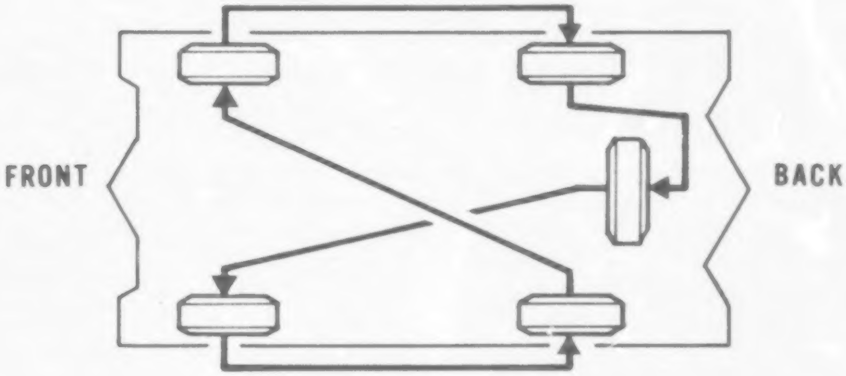
I. Tools and equipment required

- A. Hydraulic floor jack
- B. Four jack stands
- C. Lug wrench or impact wrench
- D. Rubber mallet
- E. Large common screwdriver

II. Procedures

(NOTE: This procedure is used on bias only. Radials are rotated front to rear.)

- A. Place vehicle on jack stands.
- B. Remove the hubcaps with the large screwdriver.
- C. Remove the lug nuts with the lug wrench.
- D. Remove the spare tire and wheel from the truck or rack.
- E. Mount the spare on the left front.
- F. Mount the left front on the left rear.



Bias or Belted Bias

G. Mount the left rear on the right front.

H. Mount the right front on the right rear.

I. Place the right rear tire and rim in the trunk or on the rack.

J. Tighten all lug nuts securely.

K. Install the hubcaps using the rubber hammer.

L. Remove the jack stands.

M. Lower the car to the floor.

N. Clean the work area and turn in tools.

UNIT X

WHEELS, BEARINGS, AND TIRES

UNIT TEST

1. Match the terms on the right to the correct definition:

_____a. An inner and outer race separated by steel balls

_____b. A wheel made of magnesium, usually lightweight, sporty, and comes in many sizes

_____c. Inner or outer ring for ball bearings to run on

_____d. Rim having two safety ridges, to prevent the tire from leaving the rim in event of blowout

_____e. A bearing that has been lubricated at the factory and sealed

_____f. A wide, smooth tire providing maximum traction

_____g. Even distribution of weight around the axis of rotation

_____h. A bearing with tapered steel rollers between an inner and outer race

_____i. Balancing for both static and dynamic balance

_____j. Part of tire between tread and bead of tire

_____k. Part of tire that contacts the road

_____l. Condition that causes front tires to hop up and down

_____m. Fasteners that hold the wheel to the hub

_____n. Machine on which to balance wheels.

1. Mag wheel
2. Safety rim
3. Slicks
4. Tapered roller bearing
5. Tire sidewall
6. Tramp
7. Wheel balance
8. Ball bearing
9. Race
10. Sealed bearing
11. Static balance
12. Tire balancer
13. Tire tread
14. Lug bolt and nut

2. Select the proper safety rules associated with wheels, bearing, and tires by placing a " ✓ " in front of each that is correct.

_____a. Use jack stands only when the complete car is lifted off the ground.

_____b. Place jack stands anywhere they will easily fit.

_____c. Tighten lug nuts securely.

_____d. Do not replace tires until they become slick.

_____e. Keep the front end aligned.

_____f. Rotate tires at 5,000 mile intervals.

_____g. Inflate tires rapidly because there is no danger.

_____h. Keep hands and fingers from between bead and flange when inflating tires.

_____i. Observe tire wear patterns.

_____j. Inflate tires until they feel tight.

_____k. Use a rubber lubricant only when mounting new tires.

_____l. Use the same cotter pin that was removed when replacing the hub nut.

_____m. Tighten the hub nut securely.

_____n. Always use the same bearing in the wheel it came out of.

_____o. Hand-tool safety does not apply to tire changing.

3. List five faults you may find when inspecting a damaged wheel.

a.

b.

c.

d.

e.

4. Determine the causes of improper tire wear by writing one of the following conditions by each illustration.

Under-inflation

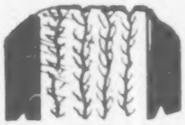
Over-inflation

Excessive cornering speed

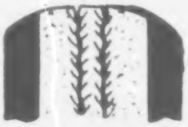
Incorrect toe-in or toe-out adjustment

Incorrect camber adjustment

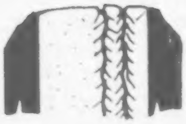
a.



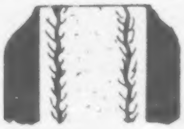
d.



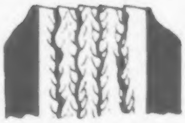
b.



e.



c.



5. Name the two methods of repairing a punctured tire.

a.

b.

6. Explain the purpose of rotating tires.

7. Demonstrate the ability to:
   - a. Remove and install a wheel.
   - b. Inspect a wheel for damage.
   - c. Remove wheel bearings
   - d. Clean, inspect, and pack bearings.
   - e. Install wheel bearings.
   - f. Remove a tire from a rim.
   - g. Install a tire on a rim.
   - h. Repair a punctured tire.
   - i. Balance a wheel and tire.
   - j. Rotate the tires including the spare.

   (NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT X

WHEELS, BEARINGS, AND TIRES

ANSWERS TO TEST

1. 8 a.

1 b.

9 c.

2 d.

10 e.

3 f.

11 g.

4 h.

7 i.

5 j.

13 k.

6 l.

14 m.

12 n.

2. ____ a.

____ b.

✓ c.

____ d.

✓ e.

✓ f.

____ g.

✓ h.

✓ i.

____ j.

____ k.

____ l.

✓ m.

✓ n.

____ o.

3. a. Dents

b. Cracks

c. Excessive wear in bolt holes

d. Burrs

e. Warpage

4. a. Excessive cornering speed

b. Incorrect camber adjustment

c. Incorrect toe-in or toe-out adjustment

d. Under inflation

e. Over inflation

5. a. Plug b. Patch

6. To make the set of tires wear evenly
7. Evaluated to the satisfaction of the instructor.

UNIT XI

BRAKE SYSTEM

UNIT OBJECTIVE

After completion of this unit, the student will be able to discuss, service, and replace components of drum and disc braking systems. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Explain the purpose of the brake system.
2. Match the terms and definitions associated with the brake system.
3. Identify the components of the wheel cylinder.
4. Identify the components of the brake mechanism.
5. Identify the components of the master cylinder.
6. Point out the cause of each brake system malfunction.
7. Demonstrate the ability to:
    a. Service the master cylinder and power booster.
    b. Replace the brake shoes.
    c. Rebuild a wheel cylinder.
    d. Bleed air from the brake system.
    e. Replace disc pads.
    f. Service the caliper and disc.
    g. Adjust the parking brake.

UNIT XI

BRAKE SYSTEM

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and job sheets.

   F. Demonstrate the procedures outlined in the job sheets.

   G. Give test.

II. Students:

   A. Read the objective.

   B. Study the information sheet.

   C. Complete each job sheet.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in the unit:

   A. Objectives

   B. Information sheets

      1. Information Sheet #1--The Brake System Terminology and Components

      2. Information Sheet #2--Troubleshooting

   C. Transparency masters

      1. TM-1--The Hydraulic Principle

      2. TM-2--Hydraulic Brake Schematic

3. TM-3--Single-Piston Master Cylinder
4. TM-4--Double-Piston Master Cylinder
5. TM-5--Wheel Cylinder
6. TM-6--Exploded View of Brake Assembly
7. TM-7--Master Cylinder with Power Booster

D. Job Sheets

1. Job Sheet #1--Service the Master Cylinder and Power Booster
2. Job Sheet #2--Replace the Brake Shoes
3. Job Sheet #3--Rebuild the Wheel Cylinder
4. Job Sheet #4--Bleed Air from the Brake System
5. Job Sheet #5--Replace the Disc Pads
6. Job Sheet #6--Service the Caliper and Disc
7. Job Sheet #7--Adjust the Parking Brake

E. Test

F. Answers to test

II. References:

A. Stockel, Martin W. Automechanics Fundamentals. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1975.

B. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1975.

UNIT XI

BRAKE SYSTEM

INFORMATION SHEET #1--THE BRAKE SYSTEM TERMINOLOGY AND COMPONENTS

I. Purpose

The purpose of the brake system is to apply hydraulic pressure in the system, which produces friction between the brake shoe and drum, causing the automobile to slow or stop.

II. Terms and definitions

- A. Master cylinder--The part of the hydraulic system in which pressure is generated
- B. Wheel cylinder--The part of the system that receives pressure from the master cylinder and applies it to brake shoes in the brake drum
- C. Brake shoes--The part of the brake system with an attached brake lining which creates friction when it comes into contact with the brake drum
- D. Brake drum--A cast iron or aluminum housing, bolted to the wheel, that rotates around the brake shoes and gives a surface for the brake shoes to rub against
- E. Disc brakes--A brake system which uses a steel disc with a caliper type of lining holder instead of the internal brake shoe type
- F. Caliper--A clamping device which holds the wheel cylinder and pads on the disc brake
- G. Pads--A type of brake lining used with disc brakes
- H. Brake backing plate--A rigid steel plate to which brake shoes are attached
- I. Brake fluid--A special fluid designed for the hydraulic brake systems
- J. Bleeding the brakes--Removing air from the hydraulic system
- K. Brake fade--A reduction in braking force due to loss of friction between brake shoes and drum, caused by heat buildup

L. Booster--A device placed in a braking system to increase the pressure output and decrease the amount of effort required to operate the brakes

III. Wheel cylinder components

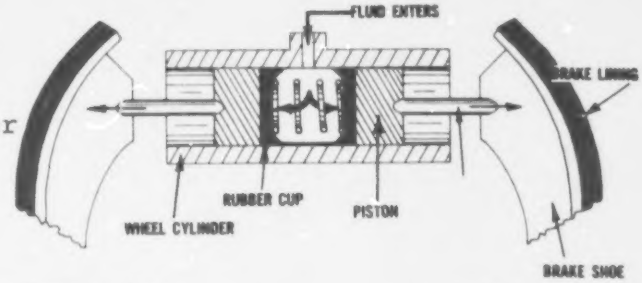
A. Piston

B. Rubber cup

C. Wheel cylinder

D. Brake lining

E. Brake shoe


FLUID ENTERS
BRAKE LINING
RUBBER CUP
PISTON
WHEEL CYLINDER
BRAKE SHOE

IV. Brake mechanism components

A. Primary shoe

B. Secondary shoe

C. Backing plate

D. Rod

E. Hole covers

F. Secondary return spring

G. Retainer

H. Spring

I. Adjusting lever

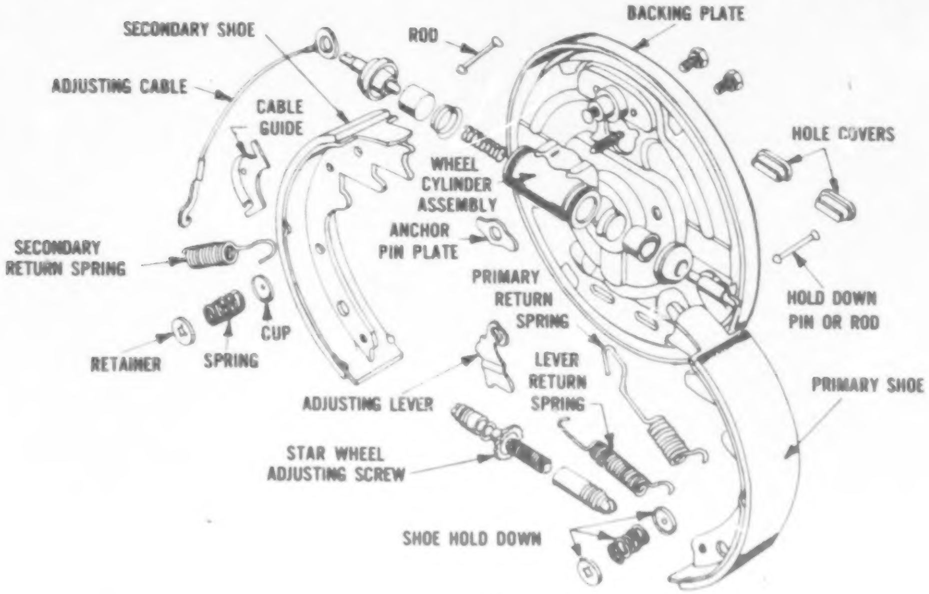
J. Star wheel adjusting screw

K. Wheel cylinder assembly

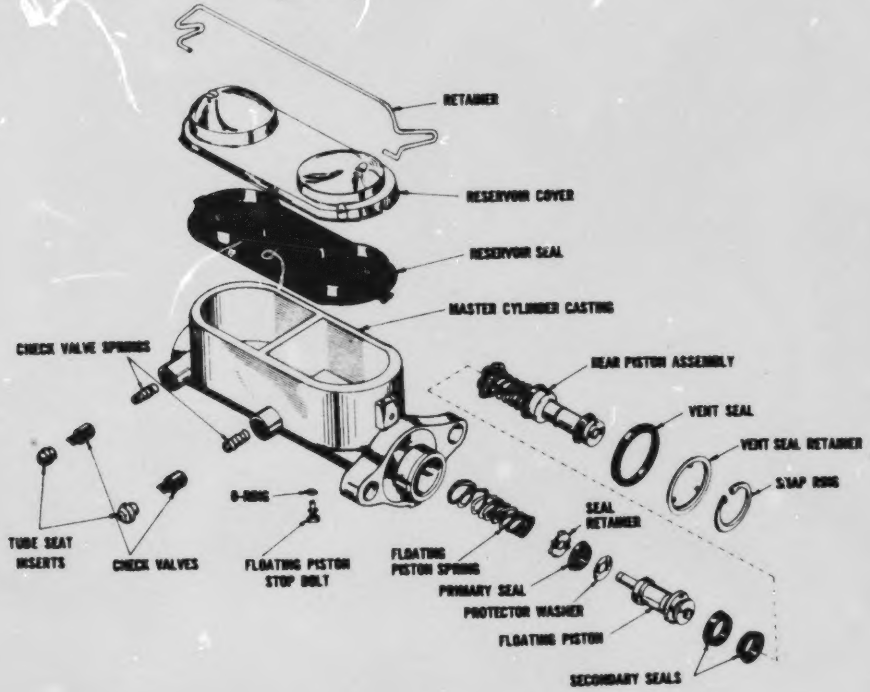
L. Anchor pin plate

M. Primary return spring

N. Lever return spring


SECONDARY SHOE
ROD
BACKING PLATE
ADJUSTING CABLE
CABLE GUIDE
HOLE COVERS
WHEEL CYLINDER ASSEMBLY
ANCHOR PIN PLATE
SECONDARY RETURN SPRING
PRIMARY RETURN SPRING
HOLD DOWN PIN OR ROD
CUP
RETAINER
SPRING
LEVER RETURN SPRING
PRIMARY SHOE
ADJUSTING LEVER
STAR WHEEL ADJUSTING SCREW
SHOE HOLD DOWN

V. Master cylinder components
   A. Retainer
   B. Reservoir cover
   C. Reservoir seal
   D. Master cylinder casting
   E. Rear piston assembly
   F. Vent seal
   G. Vent seal retainer
   H. Snap ring
   I. Secondary seals
   J. Floating piston
   K. Protector washer
   L. Primary seal
   M. Floating piston
   N. Floating piston stop bolt
   O. Check valves
   P. O-Ring
   Q. Tube seat inserts
   R. Check valve springs


RETAINER
RESERVOIR COVER
RESERVOIR SEAL
MASTER CYLINDER CASTING
CHECK VALVE SPRINGS
REAR PISTON ASSEMBLY
VENT SEAL
VENT SEAL RETAINER
SNAP RING
O-RING
SEAL RETAINER
TUBE SEAT INSERTS
CHECK VALVES
FLOATING PISTON STOP BOLT
FLOATING PISTON SPRING
PRIMARY SEAL
PROTECTOR WASHER
FLOATING PISTON
SECONDARY SEALS

UNIT XI

BRAKE SYSTEM

INFORMATION SHEET #2--TROUBLESHOOTING

VI. Brake system malfunctions and causes

- A. Low pedal
    1. Excess clearance between the brake lining and drum
    2. Automatic adjusters not working
    3. Fluid leaking from the system
    4. Air in the system
    5. Low fluid level
- B. Springy, spongy pedal
    1. Air trapped in system
    2. Improper lining thickness
    3. Drums worn too thin
- C. Excess pedal pressure required to stop car
    1. Incorrect lining
    2. Grease or fluid on several linings
    3. Lining not fully contacting drum
    4. A frozen master or wheel cylinder piston
    5. Glazed linings
- D. Pulsating brake pedal
    1. Drums out of round
    2. Disc warped
    3. Loose wheel bearings
    4. Bent rear axle

E. Brakes fade

  1. Incorrect lining
  2. Linings not properly contacting
  3. Thin brake drums
  4. Dragging brakes

F. Brakes drag when properly adjusted

  1. Pedal not returning to stop
  2. By-pass port of master cylinder closed

G. One wheel drags

  1. A we[illegible] or broken shoe retracting spring
  2. Improper adjustment
  3. Piston sticking in wheel cylinder
  4. Drum out of round

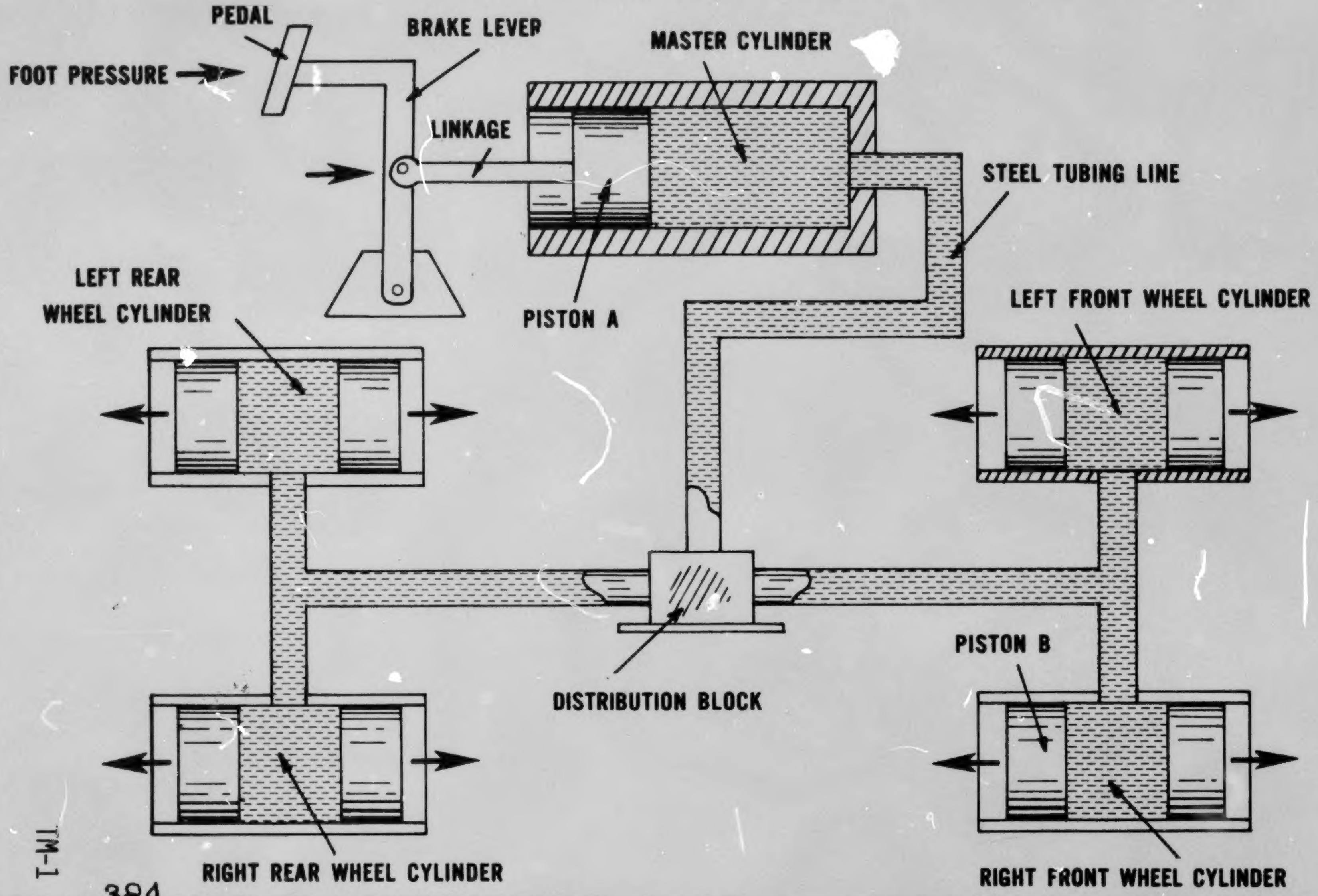
H. Rear brakes drag

  1. Improper parking brake adjustment
  2. A frozen parking brake cable

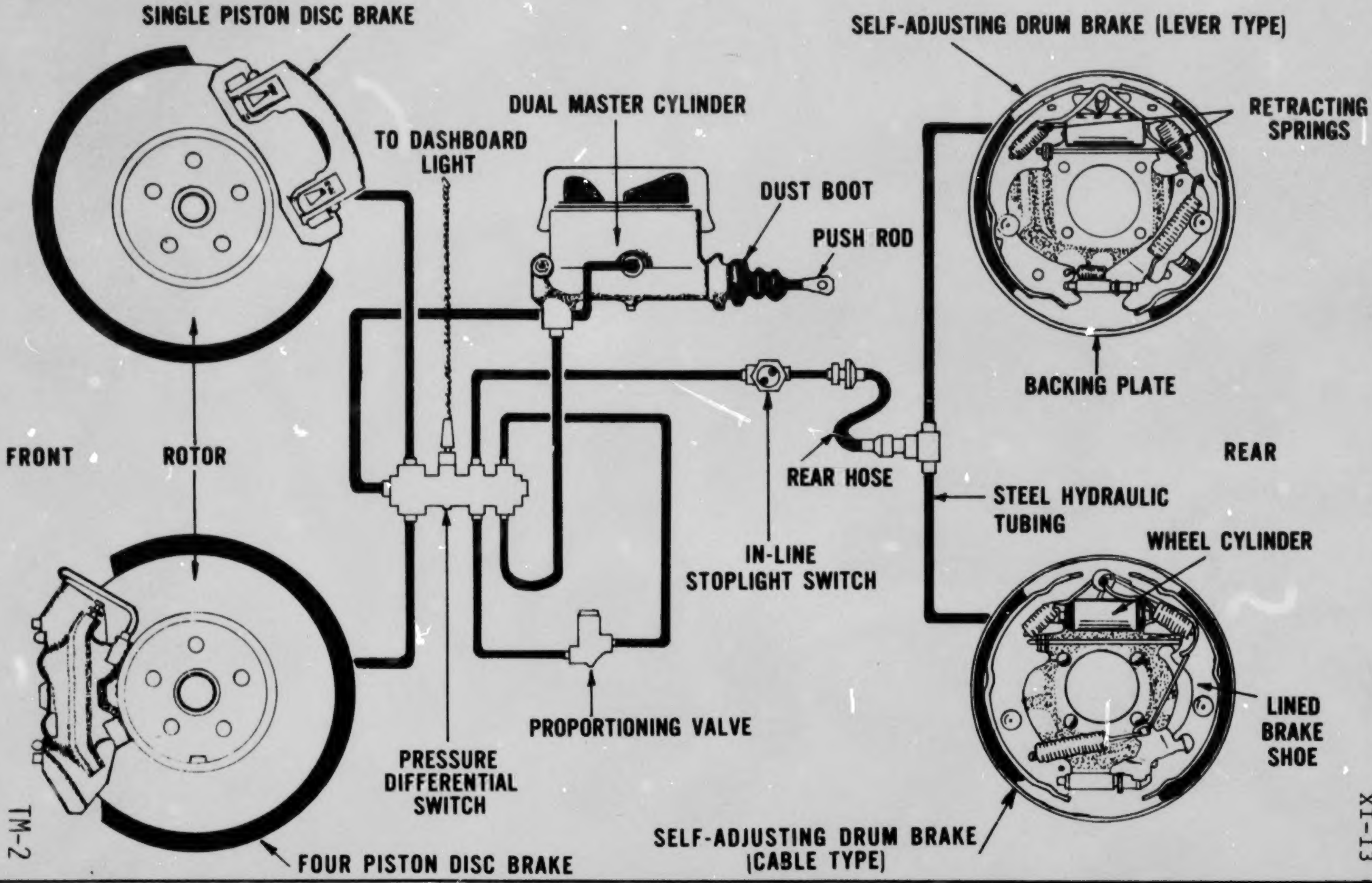
I. Car pulls to one side

  1. Grease or fluid on the lining
  2. Improper adjustment
  3. Incorrect lining on one side
  4. Primary and secondary shoes reversed on one side
  5. Loose backing plate or wheel bearings

THE HYDRAULIC PRINCIPLE


PEDAL
FOOT PRESSURE
BRAKE LEVER
LINKAGE
MASTER CYLINDER
STEEL TUBING LINE
PISTON A
LEFT REAR WHEEL CYLINDER
LEFT FRONT WHEEL CYLINDER
DISTRIBUTION BLOCK
PISTON B
RIGHT REAR WHEEL CYLINDER
RIGHT FRONT WHEEL CYLINDER

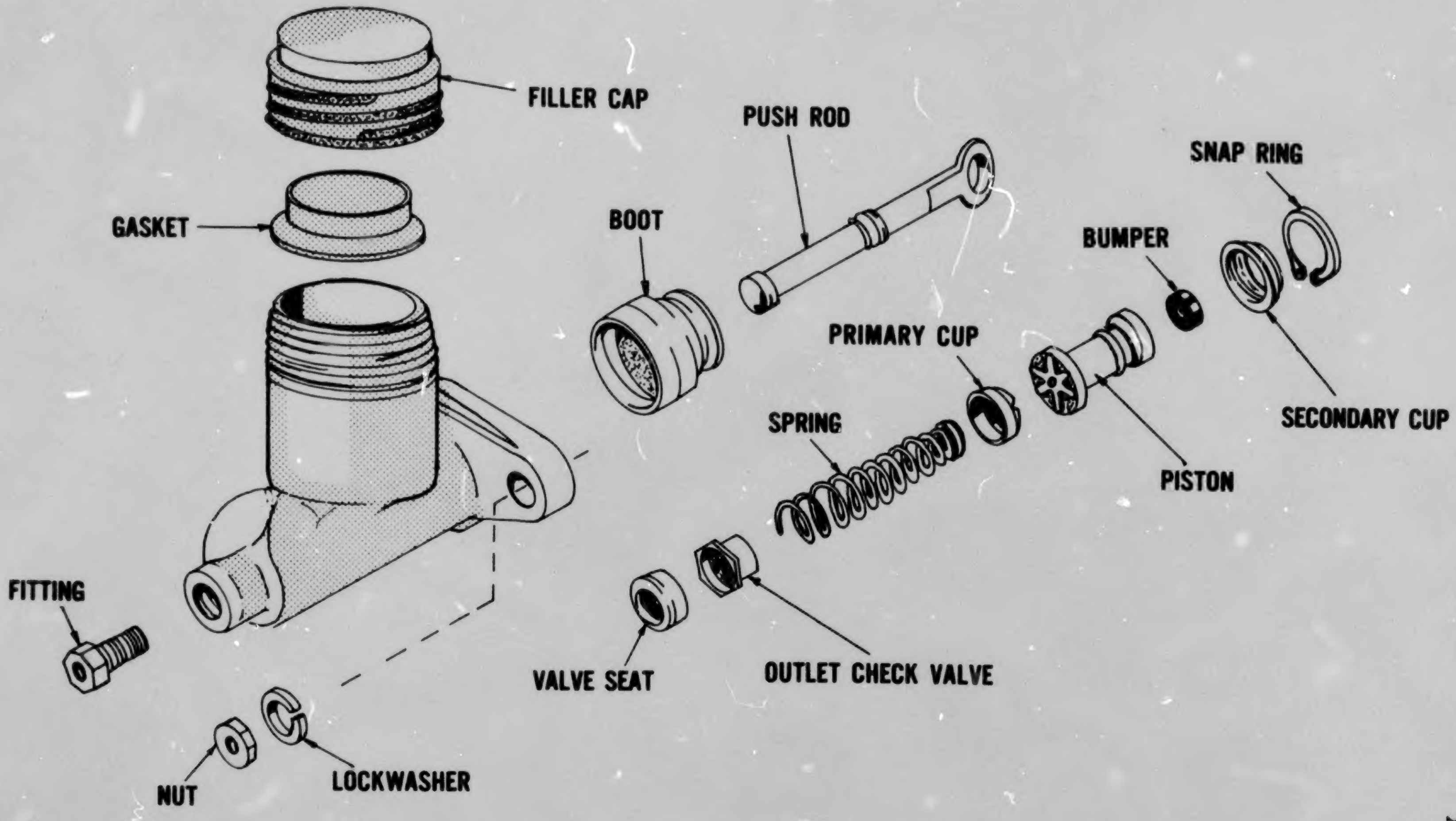
HYDRAULIC BRAKE SCHEMATIC

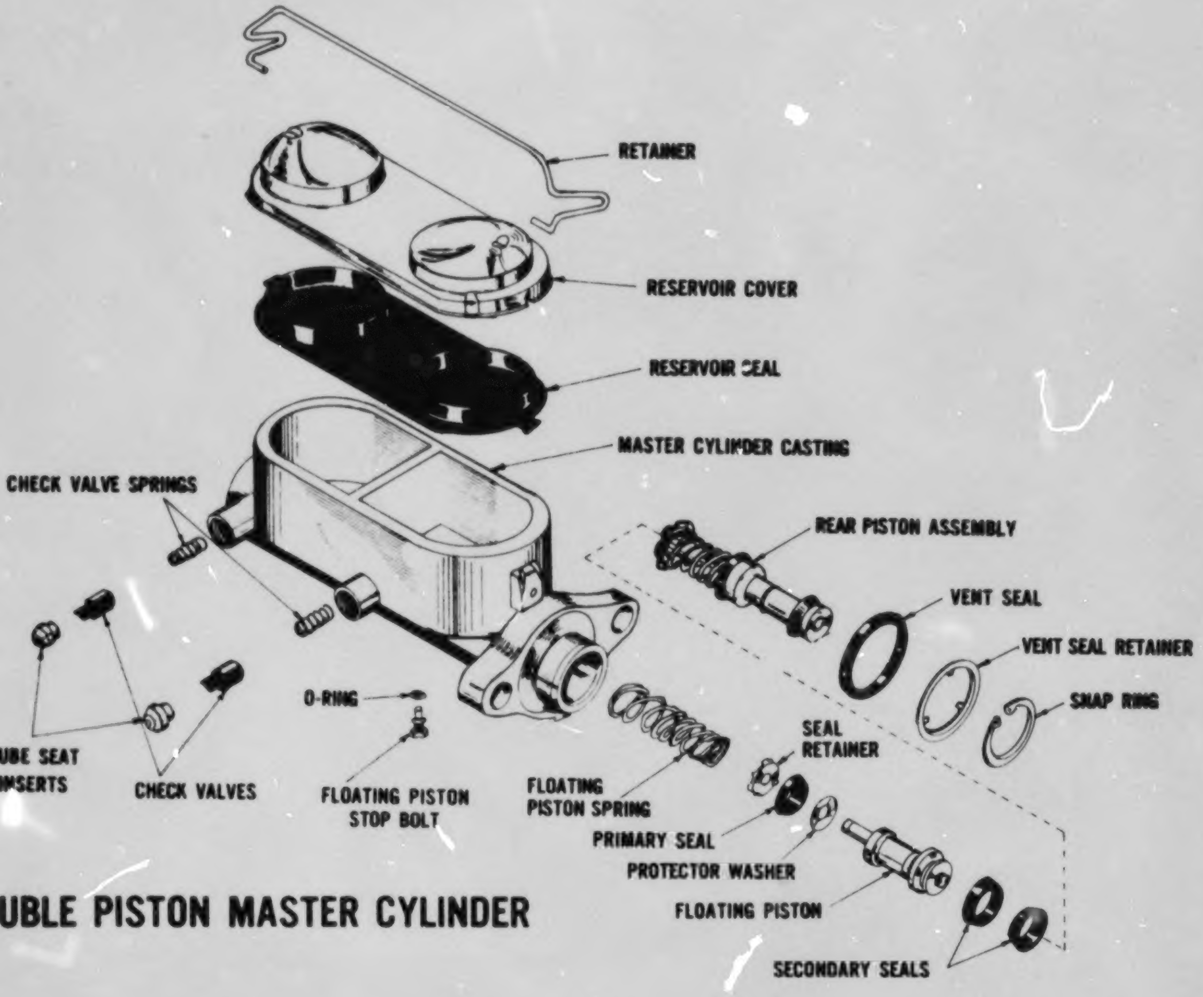

SINGLE PISTON DISC BRAKE
SELF-ADJUSTING DRUM BRAKE (LEVER TYPE)
RETRACTING SPRINGS
DUAL MASTER CYLINDER
TO DASHBOARD LIGHT
DUST BOOT
PUSH ROD
BACKING PLATE
FRONT
ROTOR
REAR HOSE
REAR
STEEL HYDRAULIC TUBING
WHEEL CYLINDER
IN-LINE STOPLIGHT SWITCH
LINED BRAKE SHOE
PROPORTIONING VALVE
PRESSURE DIFFERENTIAL SWITCH
SELF-ADJUSTING DRUM BRAKE (CABLE TYPE)
FOUR PISTON DISC BRAKE

TM-2

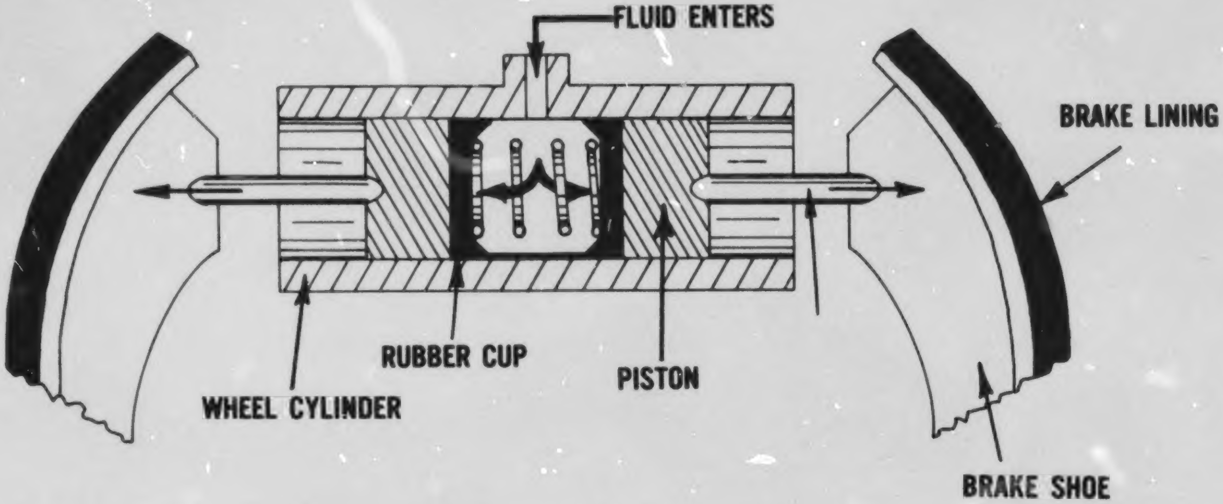
XI-13

SINGLE-PISTON MASTER CYLINDER

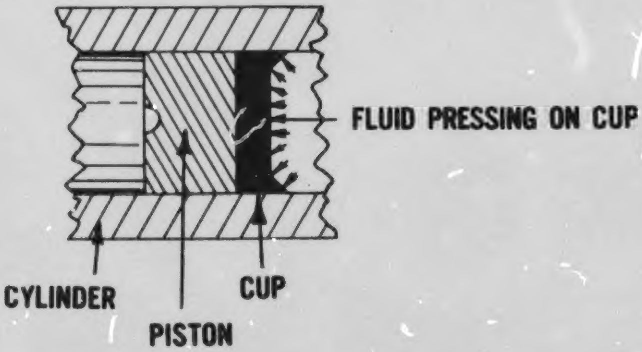

FILLER CAP
PUSH ROD
SNAP RING
GASKET
BOOT
BUMPER
PRIMARY CUP
SPRING
SECONDARY CUP
PISTON
FITTING
VALVE SEAT
OUTLET CHECK VALVE
NUT
LOCKWASHER


RETAINER
RESERVOIR COVER
RESERVOIR SEAL
MASTER CYLINDER CASTING
CHECK VALVE SPRINGS
REAR PISTON ASSEMBLY
VENT SEAL
VENT SEAL RETAINER
SNAP RING
O-RING
SEAL
RETAINER
TUBE SEAT
INSERTS
CHECK VALVES
FLOATING PISTON
STOP BOLT
FLOATING
PISTON SPRING
PRIMARY SEAL
PROTECTOR WASHER
FLOATING PISTON
SECONDARY SEALS

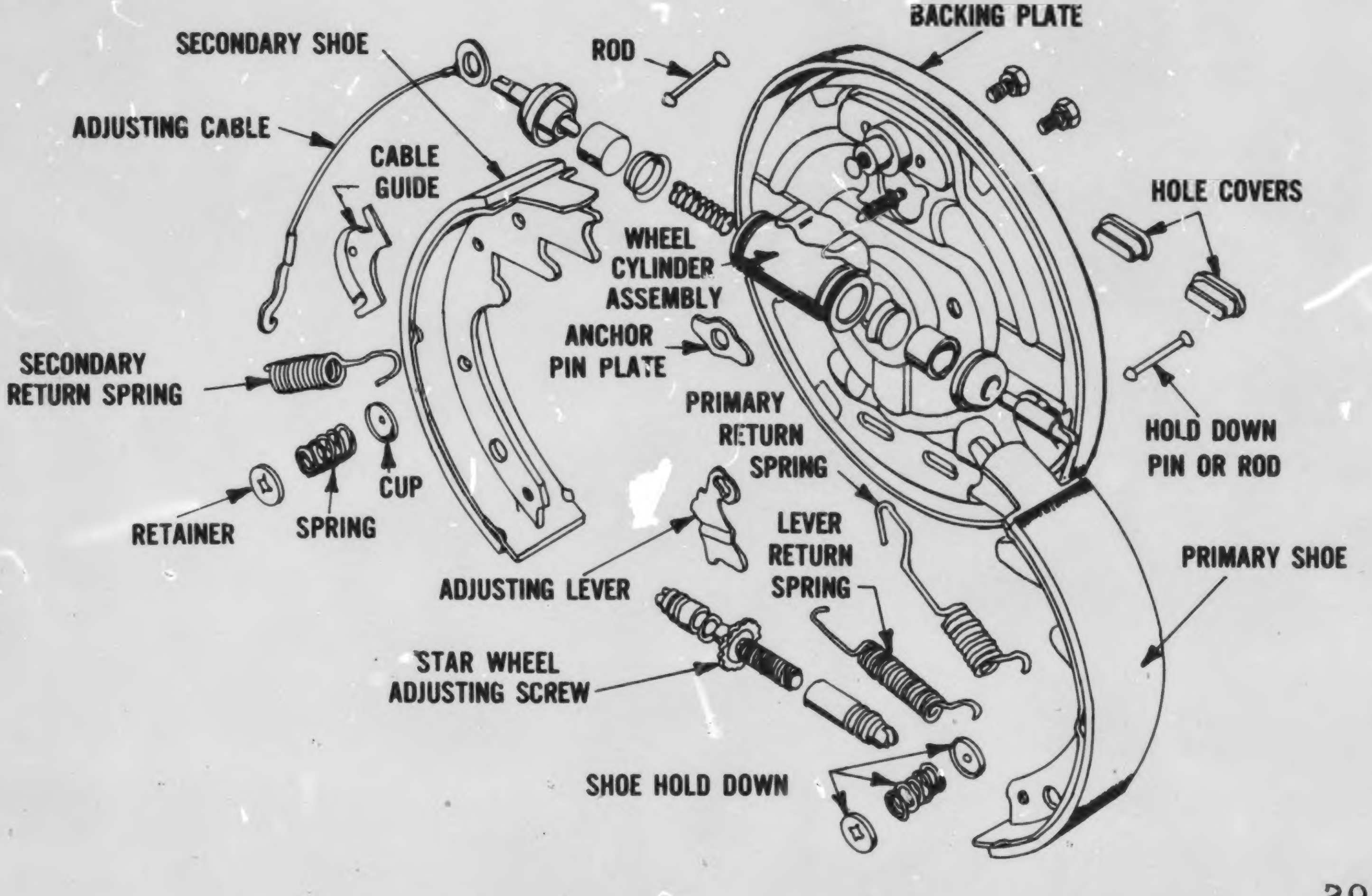
DOUBLE PISTON MASTER CYLINDER


FLUID ENTERS
BRAKE LINING
RUBBER CUP
PISTON
WHEEL CYLINDER
BRAKE SHOE

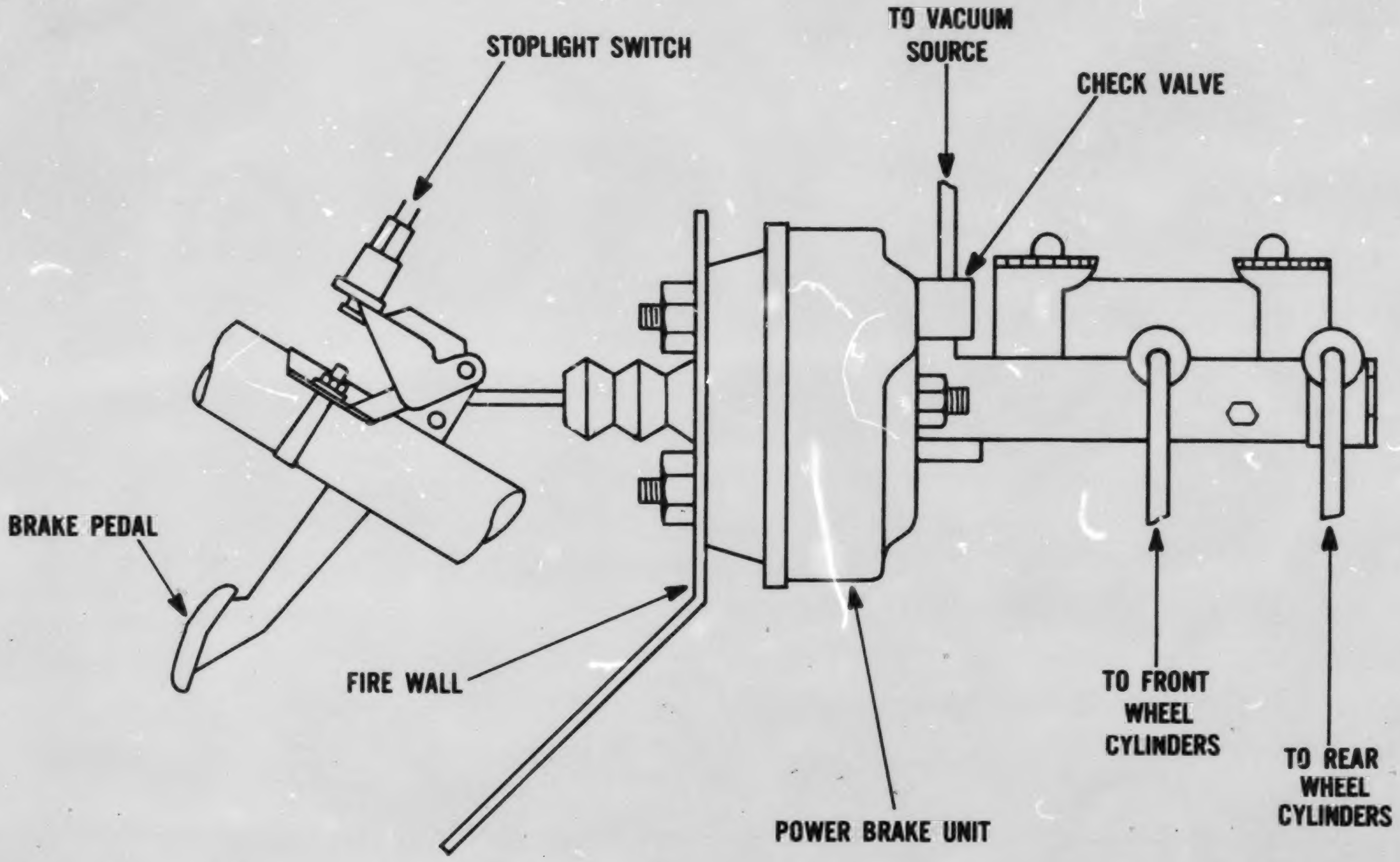
WHEEL CYLINDER


FLUID PRESSING ON CUP
CYLINDER
CUP
PISTON

EXPLODED VIEW OF BRAKE ASSEMBLY


SECONDARY SHOE
ROD
BACKING PLATE
ADJUSTING CABLE
CABLE GUIDE
HOLE COVERS
WHEEL CYLINDER ASSEMBLY
ANCHOR PIN PLATE
SECONDARY RETURN SPRING
PRIMARY RETURN SPRING
HOLD DOWN PIN OR ROD
CUP
RETAINER
SPRING
LEVER RETURN SPRING
PRIMARY SHOE
ADJUSTING LEVER
STAR WHEEL ADJUSTING SCREW
SHOE HOLD DOWN

MASTER CYLINDER WITH POWER BOOSTER


STOPLIGHT SWITCH
TO VACUUM SOURCE
CHECK VALVE
BRAKE PEDAL
FIRE WALL
POWER BRAKE UNIT
TO FRONT WHEEL CYLINDERS
TO REAR WHEEL CYLINDERS

TM-7

XI-23

UNIT XI

BRAKE SYSTEM

JOB SHEET #1--SERVICE THE MASTER CYLINDER AND POWER BOOSTER

I. Tools and materials required

A. Shop towel

B. Hose clamp pliers

C. Common screwdriver

D. 7/16" open-end wrench

E. Brake fluid

F. Fender cover

II. Procedure

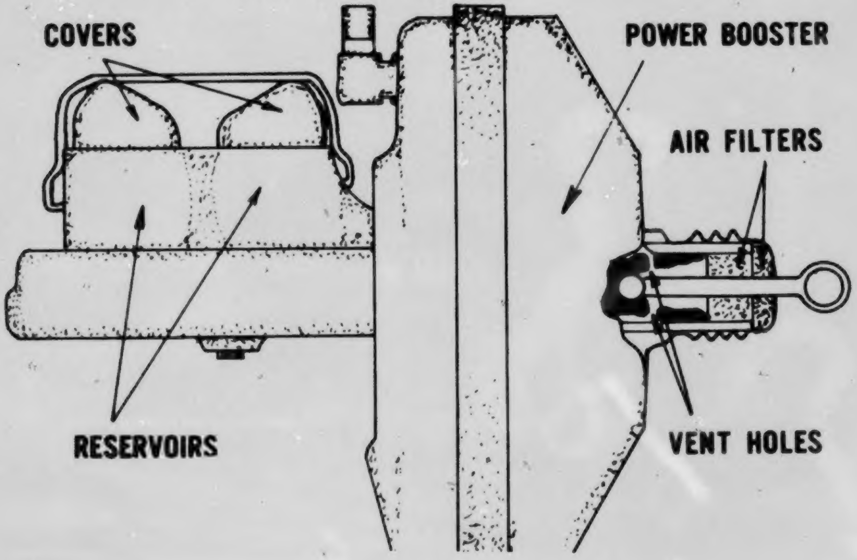
(NOTE: Follow all safety rules.)

A. Open car hood and put on fender cover.

B. Clean the area around master cylinder cover.

C. Remove the master cylinder cover.

(CAUTION: Take necessary precautions to keep all dirt out of the cylinder.)


COVERS
POWER BOOSTER
AIR FILTERS
RESERVOIRS
VENT HOLES

D. Clean any vent holes in cap.

(NOTE: Later-model vehicles have a diaphragm type of cover.)

E. Fill the master cylinder fluid reservoir.

(NOTE: There may be two cylinders.)

F. Replace the cover.

G. Check the lines to the power booster for leaks if the vehicle is equipped with power brakes.

H. Clean the filters at the air inlet.

I. Close the car hood.

J. Clean the work area and turn in tools.

UNIT XI

BRAKE SYSTEM

JOB SHEET #2--REPLACE BRAKE SHOES

I. Tools, equipment, and materials required

- A. Hydraulic floor jack
- B. Four jack stands
- C. Lug wrench
- D. Large common screwdriver
- E. Rubber mallet
- F. Box-end wrench set
- G. Brake-bleeder wrench
- H. Brake-adjusting tool
- I. Brake-spring pliers
- J. Brake fluid
- K. Fender cover
- L. Light gauge wire 18" long

II. Procedure

(NOTE: Follow all safety rules.)

- A. Raise the car enough to place jack stands.
- B. Place jack stands in a secure position.
- C. Remove the hub caps.
- D. Remove the hub dust cover.
- E. Remove the locknut cotter pin.
- F. Remove the locknut.

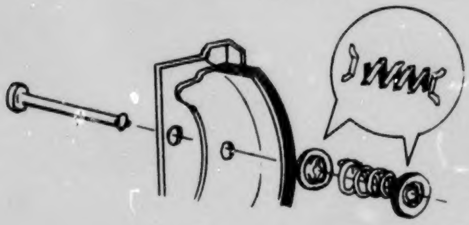
G. Remove the wheel and drum assembly.

(CAUTION: Use caution in removing bearings and wheel assembly so the spindle will not be damaged.)

H. Remove the brake shoe retracting springs with the spring pliers.

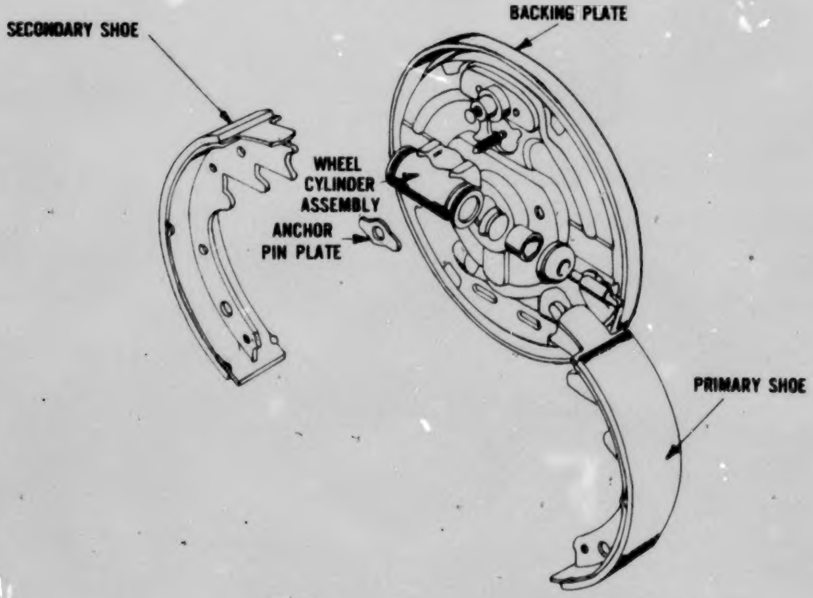
I. Remove the adjusting screw spring.

J. Remove the brake shoe hold-down springs and clips.



K. Remove the anchor pin plate.

L. Remove the brake shoes.


SECONDARY SHOE
BACKING PLATE
WHEEL CYLINDER ASSEMBLY
ANCHOR PIN PLATE
PRIMARY SHOE

M. Place a wire around brake cylinder push rods to hold the rods in place.

(NOTE: If the cylinder is to be rebuilt, the rods may be removed.)

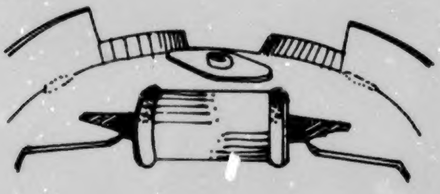
N. Clean the backing plate and brake parts.

O. Clean and repair the brake drum, if required.

P. Install new brake shoes.

(NOTE: The wide shoes go to the front wheels and the narrow shoes to the rear wheels, with the shorter shoes on the front side of each wheel.)

Q. Install the anchor-pin plate.



R. Install the brake shoe hold-down springs and clamps.

S. Install the adjusting screw spring and adjusting screw in closed position.

T. Install the brake-shoe retracting spring.

U. Install the wheel and drum assembly.

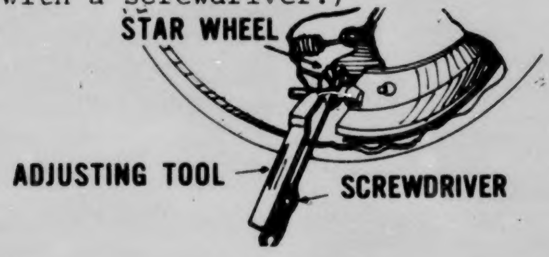
(CAUTION: Protect the spindle and bearings.)

V. Install the lock nut, lock-nut cotter pin, hub dust cover, and hub cap.

(NOTE: Refer to JOB SHEET #5 in UNIT X, WHEELS, BEARINGS, AND TIRES for proper bearing adjustment.)

W. Adjust brakes by opening the adjusting screw with the brake-adjusting tool.

(NOTE: The adjuster lever might have to be held back with a screwdriver.)



X. Adjust the shoes until they keep the wheel from rotating, and then back the adjusting screw off until the brake shoes drag only slightly.

Y. Remove the jack stands.

Z. Lower the car to the floor.

AA. Bleed the brakes and refill the master cylinder with fluid.

(NOTE: Refer to JOB SHEET #4 for bleeding instructions.)

BB. Test the car for proper braking, under the instructor's supervision.

CC. Clean the work area and turn in tools.

UNIT XI

BRAKE SYSTEM

JOB SHEET #3--REBUILD A WHEEL CYLINDER

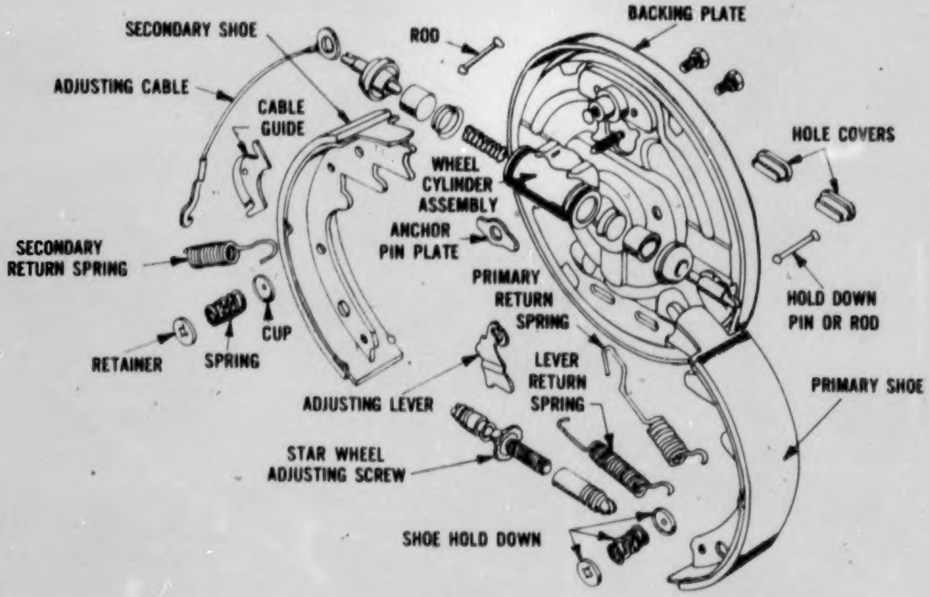
I. Tools and materials required

- A. Cylinder hone
- B. Shop rags
- C. Brake fluid
- D. Wheel-cylinder rebuilding kit
- E. Fender cover
- F. Portable electric drill

II. Procedure

(NOTE: Follow all safety rules.)

- A. Raise the hood and put on fender cover.
- B. Remove all wheel and brake parts following the procedures outlined in JOB SHEET #2.


SECONDARY SHOE
ROD
BACKING PLATE
ADJUSTING CABLE
CABLE GUIDE
HOLE COVERS
WHEEL CYLINDER ASSEMBLY
ANCHOR PIN PLATE
SECONDARY RETURN SPRING
PRIMARY RETURN SPRING
HOLD DOWN PIN OR ROD
CUP
RETAINER
SPRING
LEVER RETURN SPRING
PRIMARY SHOE
ADJUSTING LEVER
STAR WHEEL ADJUSTING SCREW
SHOE HOLD DOWN

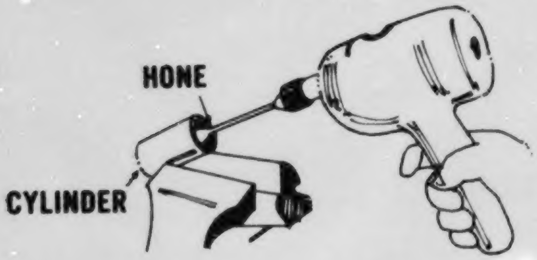
C. Remove push rods.

D. Remove cylinder from the backing plate.

E. Remove boots and cylinder assembly.

F. Clean cylinder with clean rags.

G. Hone the cylinder, using a small amount of brake fluid as lubricant.



H. Clean the cylinder of all particles.

I. Lubricate all parts with brake fluid.

J. Install new parts in wheel cylinder.

K. Install wheel cylinder on backing plate.

L. Replace all wheel and brake parts following the procedures outlined in JOB SHEET #2.

M. Test the car for proper braking under the instructor's supervision.

N. Clean work area and turn in tools.

UNIT XI

BRAKE SYSTEM

JOB SHEET #4--BLEED AIR FROM THE BRAKE SYSTEM

I. Tools and materials required

A. 3/8" box-end wrench

B. Brake fluid

C. Container to bleed fluid in

D. Small rubber hose, 18" long

E. Fender cover

II. Procedure

A. Raise hood and put on fender cover.

B. Remove master cylinder cover.

C. Fill the master cylinder with fluid.

D. Replace the cover on the master cylinder.

E. Depress brake pedal three times or until fluid passes through the bleeder valves.

(CAUTION: Keep an ample supply of brake fluid in the master cylinder.)

F. Close all bleeder valves.

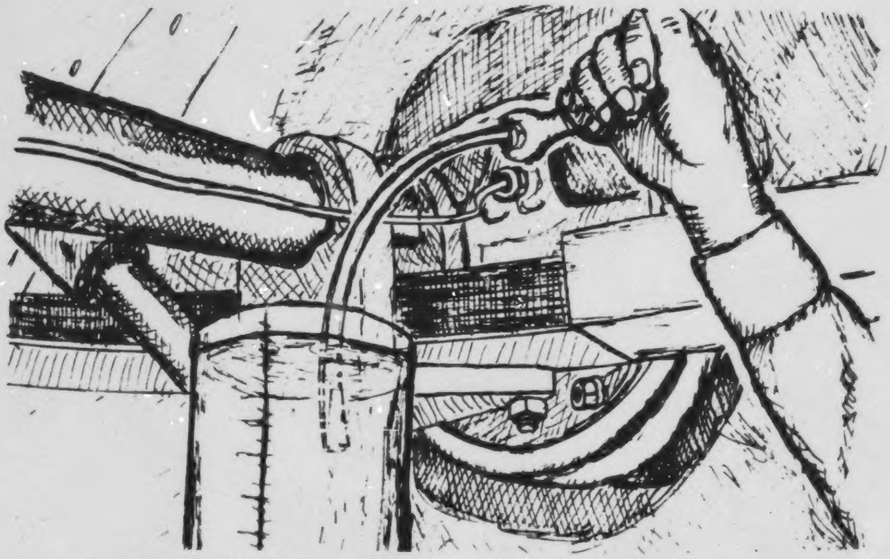
G. Pump the brake pedal until it becomes slightly firm.

H. Hold the pressure against the pedal.

I. Have someone open the bleeder valve slightly on one wheel while holding the container under the valve.

J. When the pedal reaches the floor, hold the pedal down.

K. Have the other person close the valve.



L. Repeat this operation on this wheel until no air bubbles pass through the valve.

M. Check the fluid level in the master cylinder.

N. Bleed the other wheels using the same process.

O. Check the fluid level between each wheel-bleeding.

P. If the brake warning light stays on, slightly open a front and rear-bleeder valve.

Q. Depress the brake pedal slowly, until the light goes out.

R. Hold the pedal steady.

S. Have someone close both bleeder valves.

T. Check the fluid level.

U. Close hood.

V. Clean work area and turn in tools.

UNIT XI

BRAKE SYSTEM

JOB SHEET #5--REPLACE DISC PADS

I. Tools and materials

A. Fender cover

B. Hydraulic floor jack

C. New disc brake pads

D. Pliers

E. C-clamp

F. Two jack stands

G. Shop rag

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise hood and put on fender cover.

B. Siphon about 2/3 of the brake fluid from the master cylinder's front wheel reservoir.

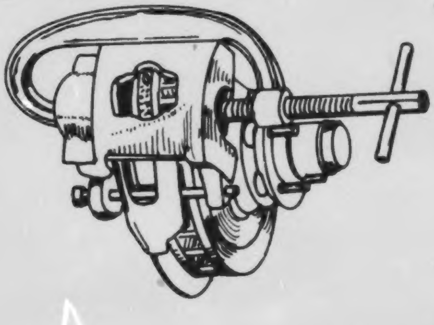
C. Raise front of vehicle enough to place jack stands.

D. Place jack stands in secure position.

E. Remove front wheels.

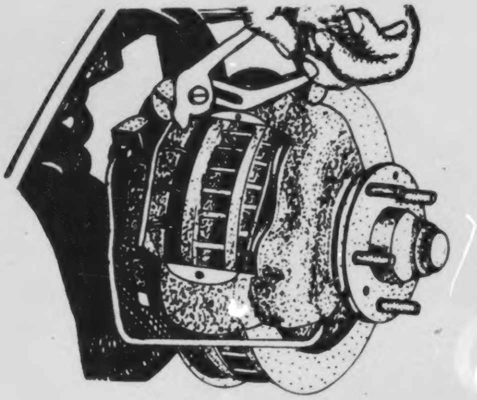
F. Remove the caliper if necessary.

G. Use a C-clamp to force the pistons back into the wheel cylinders.



H. Remove the pad retainers.

I. Pull pads out with pliers.



J. Discard worn shoes.

(NOTE: Do not replace just one pad or the pads on one wheel.)

K. Follow the procedures outlined in JOB SHEET #6 if the caliper or disc is to be repaired.

L. Install new pads.

M. Install the pad retainers.

N. Remove the C-clamp.

O. Replace the caliper, if removed.

P. Replace the front wheels.

Q. Remove jack stands.

R. Lower the car to the floor

S. Replace the brake fluid and close the cover.

T. Close the hood.

U. Clean work area and turn in tools.

UNIT XI

BRAKE SYSTEM

JOB SHEET #6--SERVICE THE CALIPER AND DISC

I. Tools and materials required

  A. Fender cover

  B. Hydraulic floor jack

  C. Pliers

  D. C-clamp

  E. Two jack stands

  F. Shop rag

  G. Micrometer

  H. Dial indicator

II. Procedure

  (NOTE: Follow all safety rules.)

  A. Disconnect the hydraulic line to the caliper.

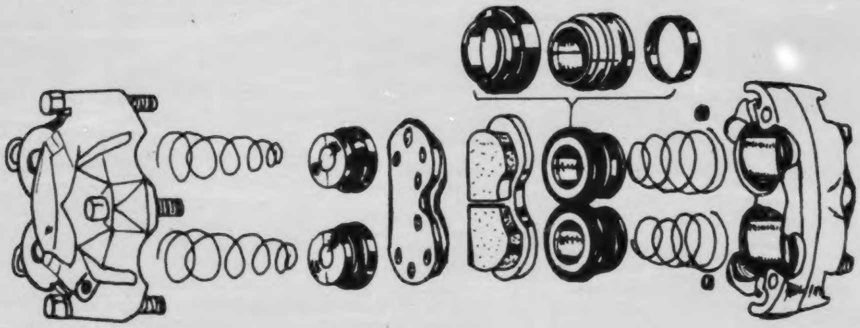
  B. Cap or plug the line.

  C. Disassemble the caliper.

  D. Check for leakage around the piston seal.

  E. Remove the piston from the cylinder.

    (NOTE: The piston may be removed by applying air pressure to the fluid fitting.)



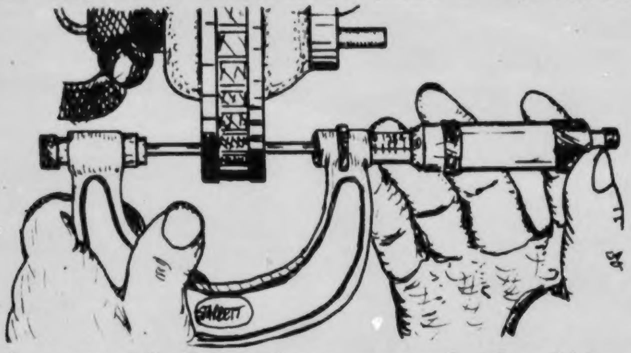
F. Clean the parts with clean brake fluid.

G. Inspect the piston bore for nicks and scratches.

H. Place piston in bore of cylinder.

I. Install the seal and dust boot.

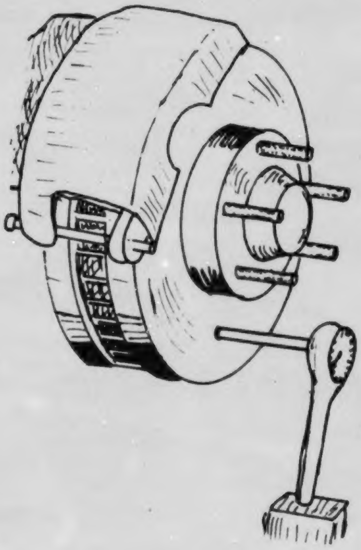
J. Check the disc thickness with a micrometer.



K. Check several locations around the disc.

L. Check the disc for cracks or roughness.

M. Mount the dial indicator in a position to check the disc for warpage.



N. Turn the disc and check the disc for warpage.

(NOTE: The disc should be replaced if the dial indicator shows movement of more than .003 of an inch.)

O. Remove the wheel hub and have it turned on a lathe if it needs repairing.

P. Replace the wheel hub if removed.

Q. Install the caliper and pads.

R. Replace the hydraulic hose.

S. Install the wheel.

T. Remove the jack stands.

U. Lower the car to the floor.

V. Replace the brake fluid and close the cover.

W. Bleed the brakes.

X. Close the hood.

Y. Clean work area and turn in tools.

UNIT XI

BRAKE SYSTEM

JOB SHEET #7--ADJUST PARKING BRAKE

I. Tools and equipment required

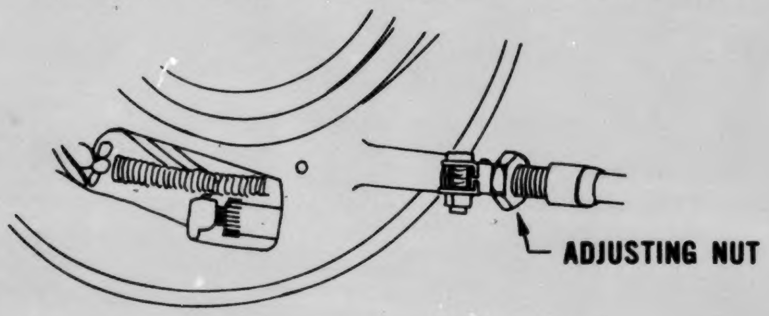
- A. Hydraulic floor jack
- B. Two jack stands
- C. 12-inch crescent wrench

II. Procedure

(NOTE: Follow all safety rules.)

- A. Check main brakes for proper adjustment.
- B. Engage parking brake.
- C. Observe the height of the parking brake pedal.
- D. Start car engine.
- E. Attempt to move car slightly forward.

  (NOTE: If car moves freely, the park brake needs adjusting.)
- F. Turn off the engine.
- G. Raise the car on a lift or jack stands.
- H. Inspect the parking brake linkages, cables, and clamps.
- I. Repair or replace any damaged parts.
- J. Adjust the cable, adjusting nut several rounds.



K. Test the car again on the floor.

L. If the brakes do not hold, adjust the cables until they function properly.

M. Clean work area and turn in tools.

UNIT XI

BRAKE SYSTEM

UNIT TEST--SECTION 1

1. Explain the purpose of the brake system.

2. Match the terms and definitions associated with the brake system.

_____a. The part of the hydraulic system in which pressure is generated

_____b. The part of the system that receives pressure from the master cylinder and applies it to brake shoes in the brake drum

_____c. The part of the brake system with an attached brake lining which creates friction when it comes into contact with the brake drum

_____d. A cast iron or aluminum housing, bolted to the wheel, that rotates around the brake shoes and gives a surface for the brake shoes to rub against

_____e. A brake system which which uses a steel disc with a caliper type of lining holder instead of the internal brake shoe type

_____f. A clamping device which holds the wheel cylinder and pads on the disc brake

_____g. A type of brake lining used with disc brakes

1. Wheel cylinder
2. Bleeding the brakes
3. Caliper
4. Brake fluid
5. Pads
6. Brake-backing plate
7. Booster
8. Brake fade
9. Master cylinder
10. Brake drum
11. Disc brakes
12. Brake shoes

_____h. A rigid steel plate to which the brake shoes are attached

_____i. A special fluid designed for the hydraulic brake system

_____j. Removing the air from the hydraulic system

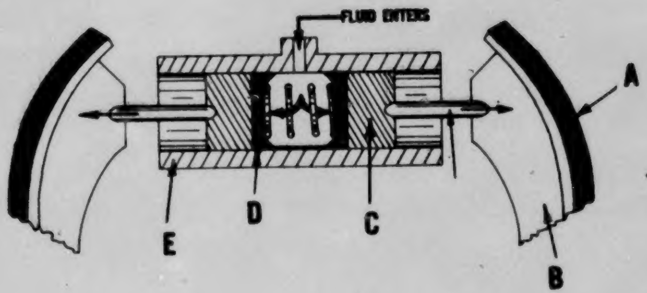
_____k. A reduction in braking force due to loss of friction between brake shoes and drum, caused by heat buildup

_____l. A device placed in a braking system to increase the pressure output and decrease the amount of effort required to operate the brakes

1. Wheel cylinder
2. Bleeding the brakes
3. Caliper
4. Brake fluid
5. Pads
6. Brake-backing plate
7. Booster
8. Brake fade
9. Master cylinder
10. Brake drum
11. Disc brakes
12. Brake shoes

3. Identify the components of the wheel cylinder by placing each of the parts names listed below in the correct blank.

Wheel cylinder
Brake lining
Cup
Piston
Brake shoe



a.
b.
c.
d.

4. Identify the components of the brake mechanism by placing each of the parts names listed below in the correct blank.

Primary shoe

Secondary shoe

Secondary return spring

Parking brake cable

Rod

Hole covers

Retainer

Spring

Adjusting lever

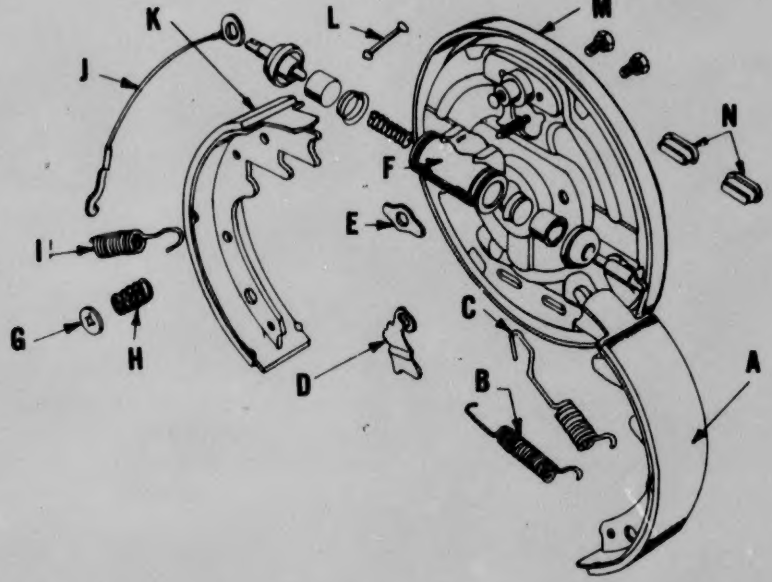
Wheel cylinder assembly

Backing plate

Anchor pin plate

Primary return spring

Lever return spring



a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

l.

m.

n.

5. Identify the components of the master cylinder by placing each of the parts names listed below in the correct blank.

Reservoir cover

Reservoir seal

Retainer

Master cylinder casting

Rear piston assembly

Vent seal

Vent seal retainer

Floating piston stop bolt

Check valves

Secondary seals

Floating piston

Protector washer

Primary seal

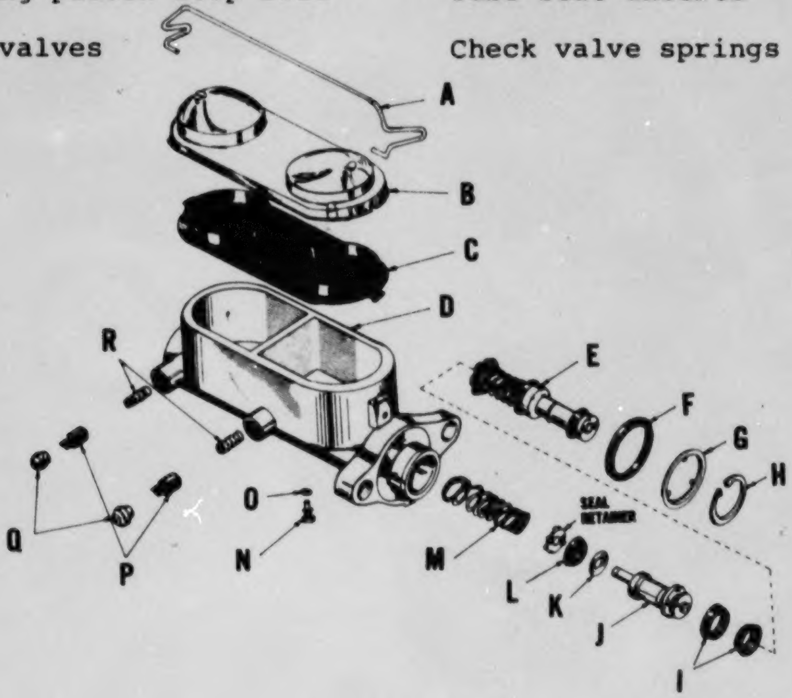
Snap ring

Floating piston spring

O-ring

Tube seat inserts

Check valve springs



a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

l.

m.

n.

o.

p.

q.

r.

UNIT XI

BRAKE SYSTEM

UNIT TEST--SECTION 2

6. Point out the cause of each of the brake system malfunctions by placing the correct number by each malfunction.

(NOTE: You may place several numbers by each letter.)

_____a. Low pedal

_____b. Spongy pedal

_____c. Excess pedal pressure required to stop car

_____d. Pulsating brake pedal

_____e. Brakes fade

_____f. Brakes drag when properly adjusted

_____g. One wheel drags

_____h. Rear brakes drag

_____i. Car pulls to one side

1. Grease on several linings
2. Drums out of round
3. Pedal not returning to stop
4. A broken retracting spring
5. Improper parking brake adjustment
6. Air trapped in system
7. Disc warped
8. Low fluid level
9. Incorrect lining on one side
10. Linings not properly contracting
11. A frozen master cylinder
12. Drums worn too thin

7. Demonstrate the ability to:
   a. Service the master cylinder and power booster.
   b. Replace the brake shoes.
   c. Bleed air from the brake system.
   d. Replace disc pads.
   e. Service the caliper and disc.
   f. Adjust the parking brake.

   (NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT XI

BRAKE SYSTEM

ANSWERS TO UNIT TEST--SECTION 1

1. The purpose of the brake system is to apply hydraulic pressure in the system, which produces friction between the brake shoe and drum and causes the automobile to slow or stop.

2. 9 a.

   1 b.

   2 c.

   10 d.

   11 e.

   3 f.

   5 g.

   6 h.

   4 i.

   2 j.

   8 k.

   7 l.

3. a. Brake lining

   b. Brake shoe

   c. Piston

   d. Cup

   e. Wheel cylinder

4. a. Primary shoe

   b. Lever return spring

   c. Primary return spring

   d. Adjusting level

   e. Anchor pin plate

   f. Wheel cylinder assembly

   g. Retainer

   h. Spring

i. Secondary return spring

j. Parking brake cable

k. Secondary shoe

l. Rod

m. Backing plate

n. Hole covers

5. a. Retainer

b. Reservoir cover

c. Reservoir seal

d. Master cylinder casting

e. Rear piston assembly

f. Vent seal

g. Vent seal retainer

h. Snap ring

i. Secondary seals

j. Floating piston

k. Protector washer

l. Primary seal

m. Floating piston spring

n. Floating piston stop bolt

o. O-ring

p. Check valves

q. Tube seat inserts

r. Check valve springs

SECTION 2

6. 8 a.

6, 12 b.

1, 11 c.

2, 7 d.

10 e.

3 f.

4 g.

5 h.

9 i.

7. Evaluated to the satisfaction fo the instructor.

UNIT XII

FRAME, SUSPENSION, AND STEERING

UNIT OBJECTIVE

After completion of this unit, the student will be able to identify major steering and suspension components. The student will be able to repair and replace parts of the steering and suspension systems. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student will be able to:

1. Match the terms and definitions associated with frame, suspension, and steering.
2. Identify the two types of frames used today.
3. List two types of suspension systems.
4. Point out the advantages of independent suspension.
5. Identify the components of the front suspension.
6. Identify the components of the steering linkage.
7. Identify each type of spring.
8. Identify each type of shock absorber.
9. Demonstrate the ability to:
    a. Remove and replace front shock absorber.
    b. Remove and replace rear shock absorber.
    c. Remove and replace lower ball joint.
    d. Remove and replace upper ball joint.
    e. Remove and replace tie rod end.
    f. Remove and replace idler arm.

UNIT XII

FRAME, STEERING, AND SUSPENSION

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheets.

   F. Demonstrate the procedures outlined on the job sheets.

   G. Give test.

II. Student:

   A. Read objectives.

   B. Study information sheet.

   C. Complete each job sheet.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM-1--The Front Suspension

      2. TM-2--Shock Absorber Mounting

      3. TM-3--Rear Suspension Coil Spring

      4. TM-4--Rear Suspension Leaf Spring

5. TM-5--Lower Ball Joint Removal
6. TM-6--Typical Steering Linkage

D. Job sheets

1. Job Sheet #1--Remove and Replace Front Shock Absorbers
2. Job Sheet #2--Remove and Replace Rear Shock Absorbers
3. Job Sheet #3--Remove and Replace Lower Ball Joint
4. Job Sheet #4--Remove and Replace Upper Ball Joint
5. Job Sheet #5--Remove and Replace Tie Rod End
6. Job Sheet #6--Remove and Replace Idler Arm

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. Auto Mechanics Fundamentals. South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1974.

B. Stockel, Martin W. Auto Service and Repair. South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1975.

UNIT XII

FRAME, SUSPENSION, AND STEERING

INFORMATION SHEET

I. Terms and definitions

A. Control arm--Holds the hub assembly, upper and lower ball joints, shock absorbers, and assists in holding coil springs in place

B. Grommet--An eyelet of rubber that protects an opening or insulates something passed through it

C. Shock absorbers--A tubular, oil-filled device that absorbs action of the springs

D. Retainer cup--A cup-shaped metal washer used to hold the grommet in place

E. Upper mounting bracket--A piece of metal that extends from the frame at the location of each spring assembly to hold one end of the shock absorber

F. Strut shaft--A shaft extending from the frame to hold one end of the shock absorber

G. Spindle assembly--The mounting of upper and lower ball joints, brake-backing plate, front-wheet hub, and tie rod ends

H. Shackle--Bracket used for mounting leaf springs to the frame

I. Idler arm--An L-shaped rod that mounts to the frame and the intermediate rod that helps support the steering linkage

J. Intermediate rod--The center link of the steering linkage

K. Ball joint--A flexible joint with a ball-and socket type of construction that is used in steering linkages

L. Stud--A straight or tapered metal rod with threads on either or both ends

M. Stabilizer bar--A springy steel bar mounted to the frame and lower control arm to control body sway and leaning when cornering

N. Coil spring--A spirally wound spring used on front and rear suspensions

O. Leaf spring--A flat spring steel suspension spring made of one or more pieces that is mainly used on the rear axle assembly

P. Steering gear--A gear box located on the end of the steering column that contains the gears necessary to multiply the turning force

Q. Steering column--A tubular housing mounted to the dash that contains a steering gear shaft to which the steering wheel is mounted

II. Types of frames

A. Conventional steel frame--The frame is a separate part, to which the body is bolted.

B. Integral body and frame--The frame and body are a single unit, with all sections welded together.

III. Types of suspension systems

A. Solid axle-leaf spring suspension

B. Independent coil-spring suspension

IV. Advantages of independent suspension

A. Keeps wheels aligned.

B. Does not transfer tipping action to the body.

V. Components of the front suspension

A. Upper control arm

B. Shock absorber

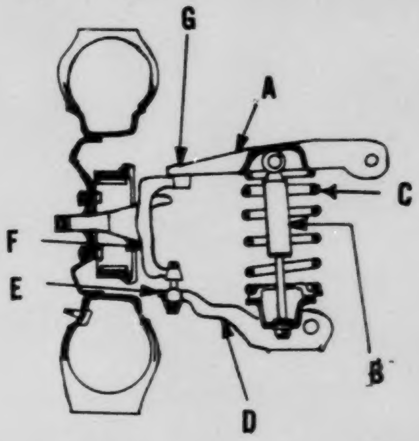
C. Coil spring

D. Lower control arm

E. Lower ball joint

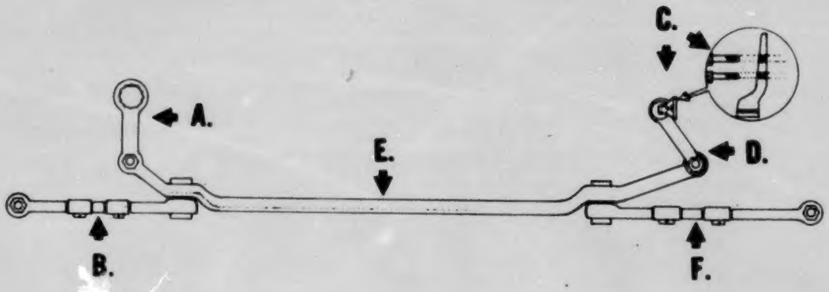
F. Steering knuckle

G. Upper ball joint



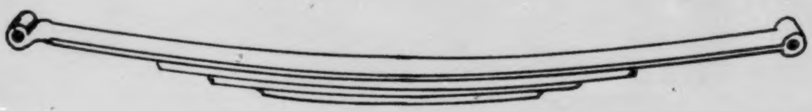
VI. Components of the steering linkage

A. Pitman arm
B. Idler arm
C. Steering arm
D. Idler arm support
E. Tie rod
F. Intermediate rod

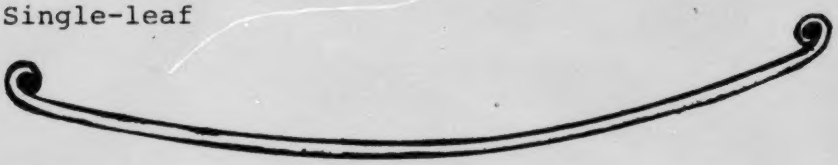


VII. Types of springs

A. Multi-leaf

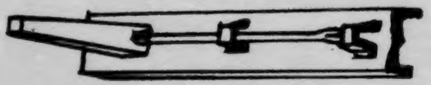


B. Single-leaf



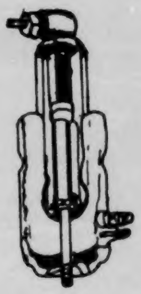
C. Coil

D. Torsion-bar

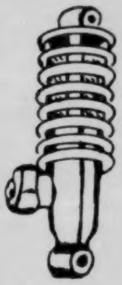


VIII. Types of shock absorbers

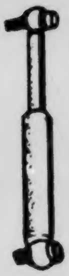
A. Superlift



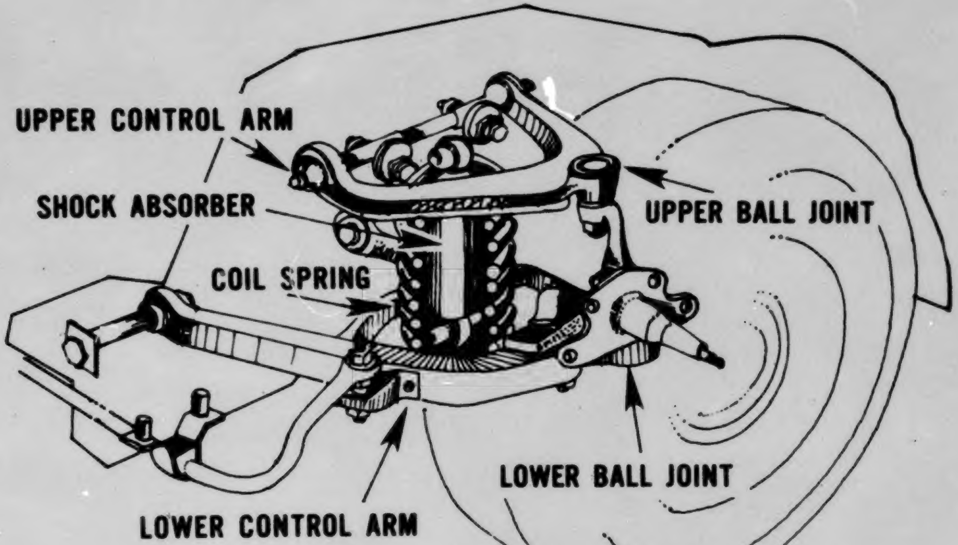
B. Adjustable

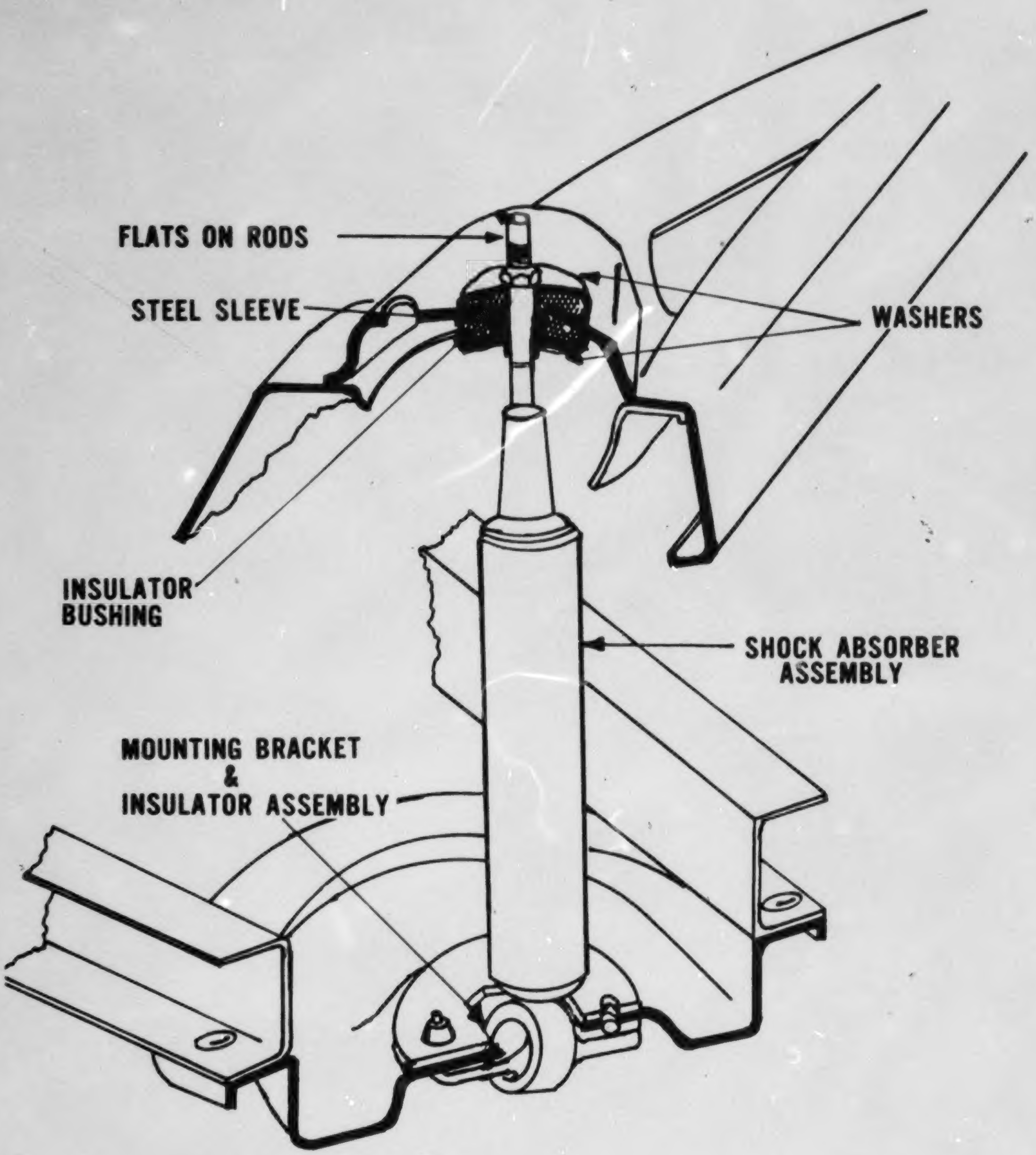


C. Telescopic



THE FRONT SUSPENSION

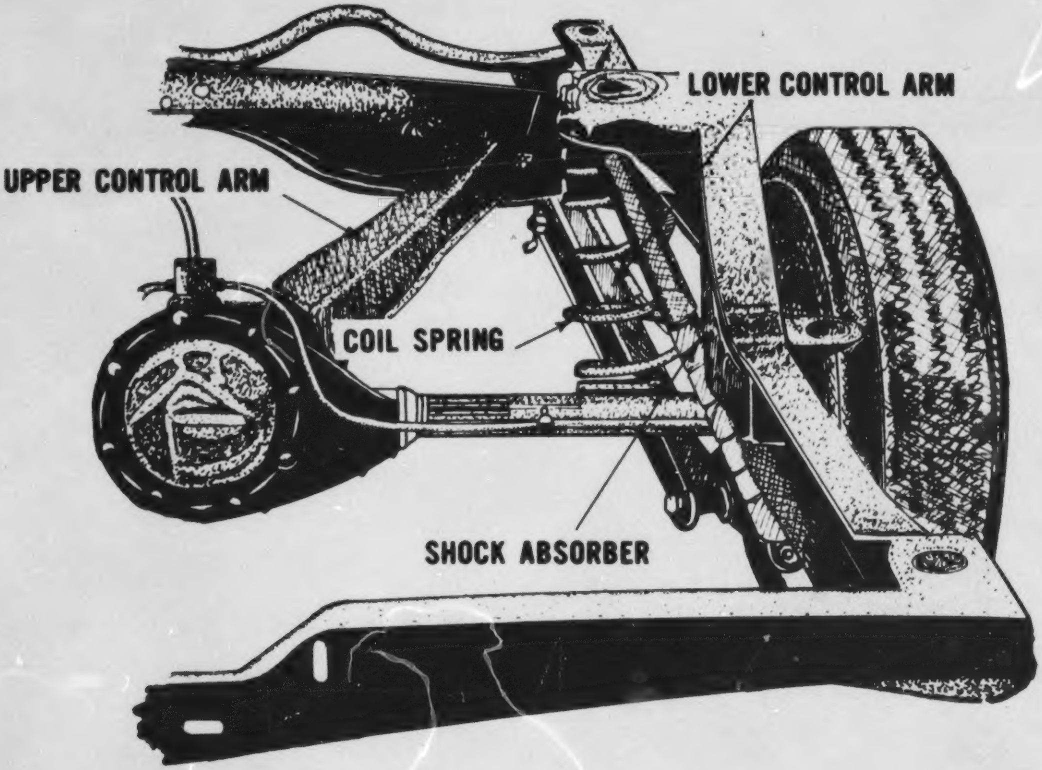

UPPER CONTROL ARM
SHOCK ABSORBER
COIL SPRING
UPPER BALL JOINT
LOWER BALL JOINT
LOWER CONTROL ARM


FLATS ON RODS
STEEL SLEEVE
WASHERS
INSULATOR BUSHING
SHOCK ABSORBER ASSEMBLY
MOUNTING BRACKET & INSULATOR ASSEMBLY

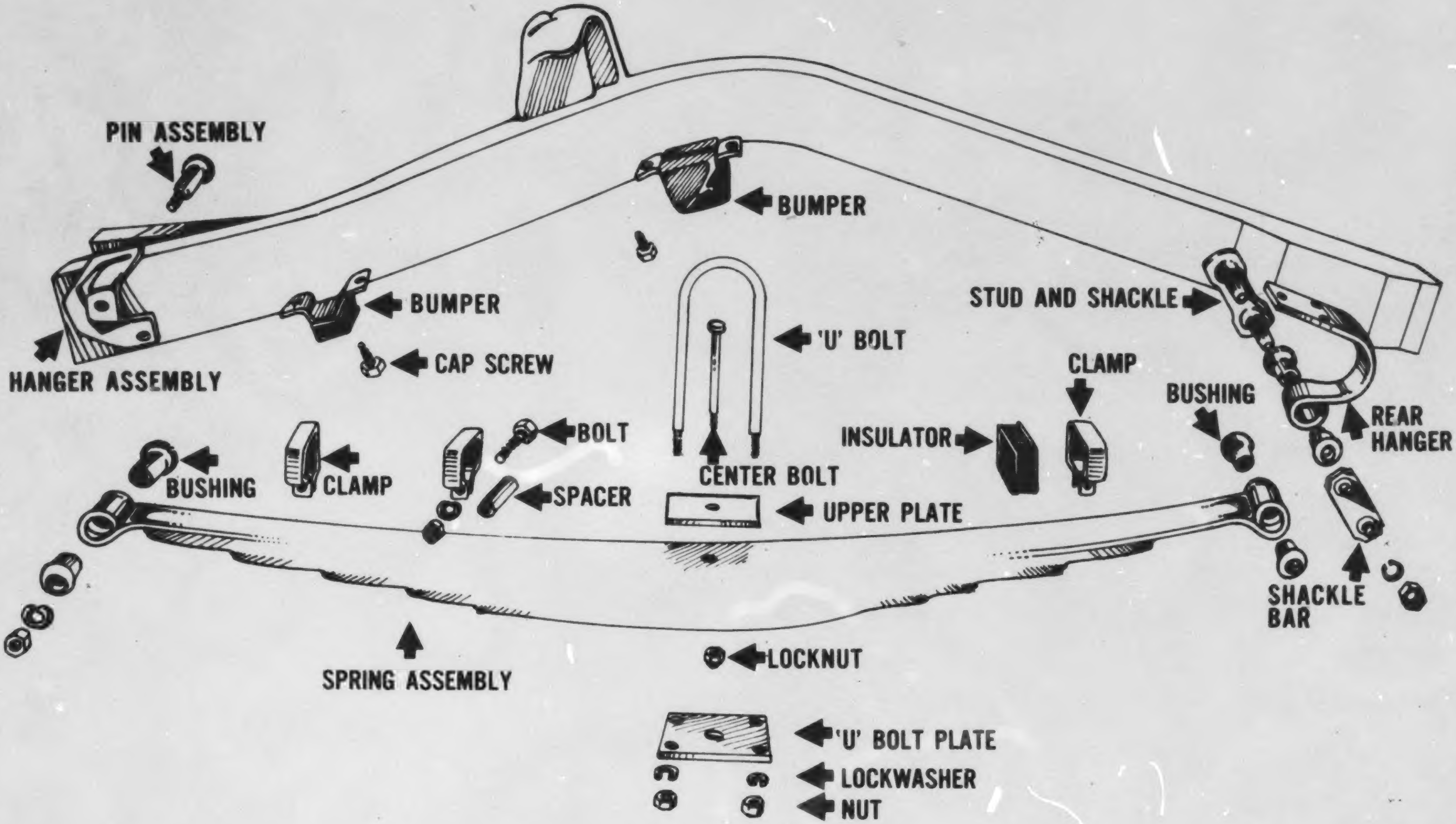
SHOCK ABSORBER MOUNTING

TM-2

REAR SUSPENSION COIL SPRING


LOWER CONTROL ARM
UPPER CONTROL ARM
COIL SPRING
SHOCK ABSORBER

REAR SUSPENSION LEAF SPRING

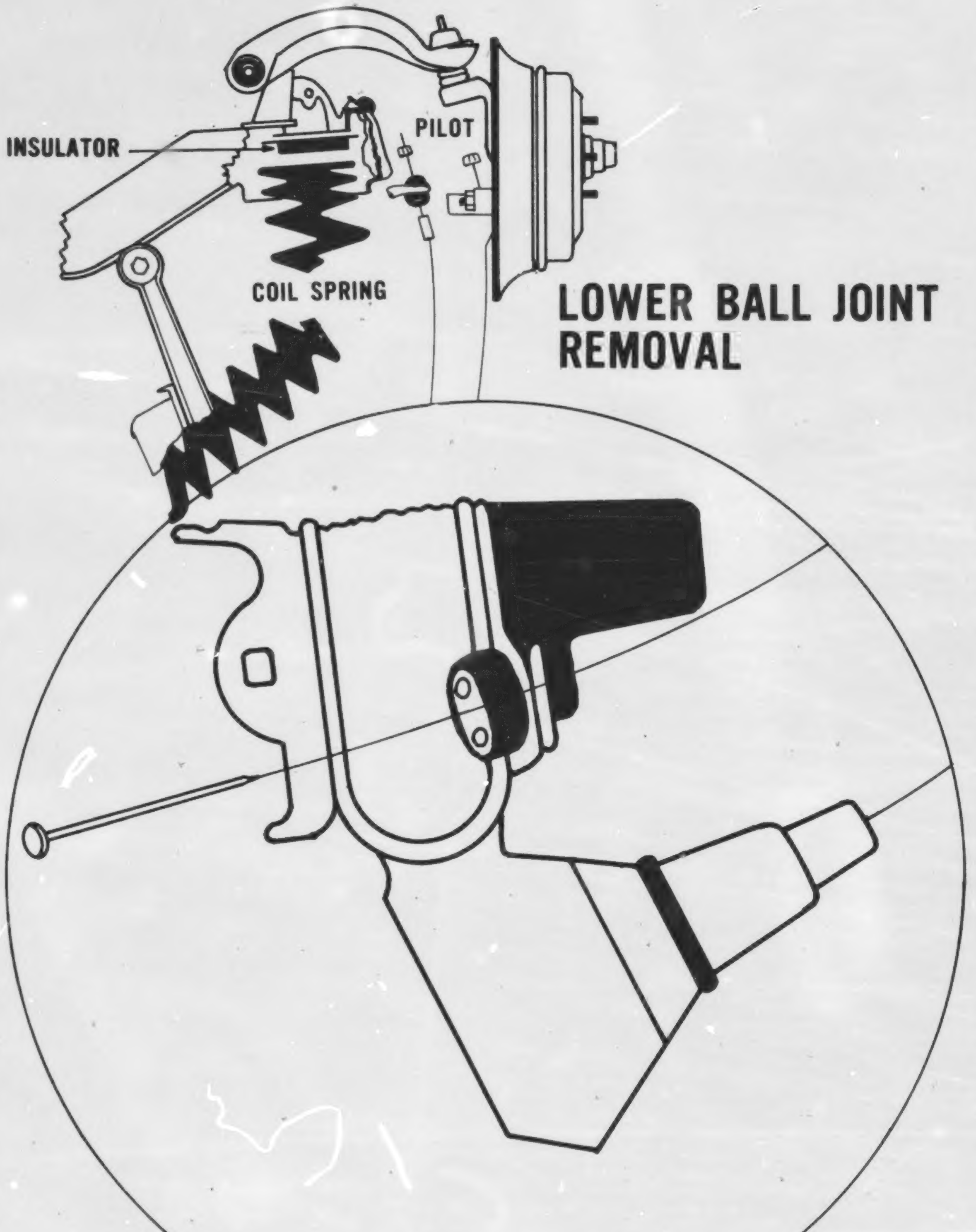

PIN ASSEMBLY
BUMPER
BUMPER
HANGER ASSEMBLY
CAP SCREW
STUD AND SHACKLE
'U' BOLT
CLAMP
BUSHING
REAR HANGER
BOLT
INSULATOR
BUSHING
CLAMP
SPACER
CENTER BOLT
UPPER PLATE
SHACKLE BAR
SPRING ASSEMBLY
LOCKNUT
'U' BOLT PLATE
LOCKWASHER
NUT

TM-4

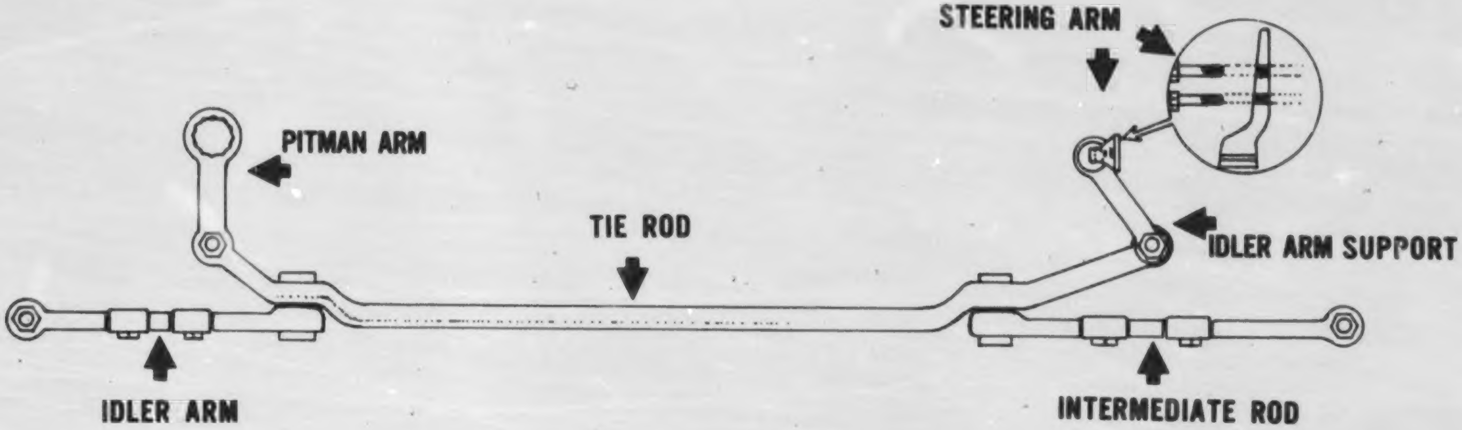
XIII-15

~~433~~

LOWER BALL JOINT REMOVAL


INSULATOR
PILOT
COIL SPRING

TM-5


STEERING ARM
PITMAN ARM
TIE ROD
IDLER ARM SUPPORT
IDLER ARM
INTERMEDIATE ROD

TYPICAL STEERING LINKAGE

UNIT XII

FRAME, SUSPENSION, AND STEERING

JOB SHEET #1--REMOVE AND REPLACE FRONT SHOCK ABSORBER

I. Tools, equipment, and materials required

A. 3/8" drive socket set

B. 12" crescent wrench

C. Box-end wrench set

D. Pry bar

E. Hydraulic floor jack

F. Two jack stands

G. Torque wrench

H. Liquid wrench

I. Auto manual

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise front of car enough to place jack stands.

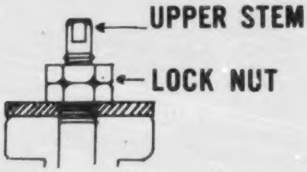
B. Place jack stands in a secure position.

C. Apply liquid wrench to the shock absorber stem nut and lower retaining bolt.

(CAUTION: Do not get liquid wrench in eyes.)

D. Remove the upper stem nut with a box-end wrench while holding the stem with a crescent wrench.

(NOTE: A lock nut may need to be removed.)



E. Remove the lower retaining bolts that hold the shock absorber to the lower control arm.

F. Pull the shock absorber through the control arm.

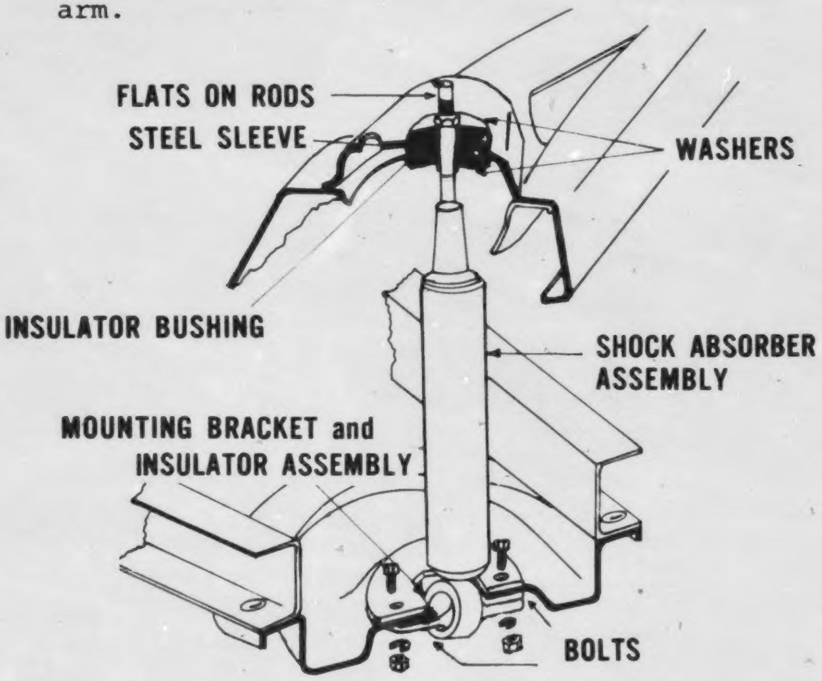
G. Pull the new shock absorber until it is fully extended.

H. Insert the shock absorber through the lower control arm.

I. Place the retainer cup and a grommet on the stem of the shock absorber.

J. Guide the stem through the upper control arm mounting hole.

K. Install the lower retaining bolts through the lower shock absorber mounting holes in the lower control arm.


FLATS ON RODS
STEEL SLEEVE
WASHERS
INSULATOR BUSHING
SHOCK ABSORBER ASSEMBLY
MOUNTING BRACKET and INSULATOR ASSEMBLY
BOLTS

L. Tighten the bolt to 20 foot-pounds of pressure with the torque wrench.

(NOTE: Torque settings may vary, so check the auto manual for exact settings.)

M. Install the top grommet, retainer cup, and nut on the shock absorber stem.

N. Hold the shock absorber stem and tighten the stem nut.

O. Install the lock nut if available.

P. Remove jack stands, lower car to the floor, and clean work area.

UNIT XII

FRAME, SUSPENSION, AND STEERING

JOB SHEET #2--REMOVE AND REPLACE REAR SHOCK ABSORBER

I. Tools, equipment, and materials required

A. 3/8" drive socket set

B. Box-end wrench set

C. Pry bar

D. Hydraulic floor jack

E. Two jack stands

F. Torque wrench

G. Liquid wrench

H. Auto manual

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise rear of car enough to place jack stands.

B. Place jack stands in a secure position.

C. Apply liquid wrench to upper and lower retaining nuts and bolts.

(CAUTION: Do not get liquid wrench in eyes.)

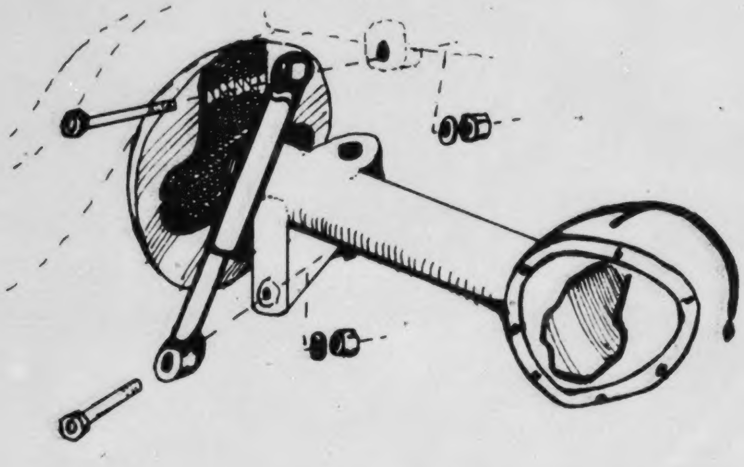
D. Disconnect air line to shock absorber if car is equipped with air shock absorbers.

E. Remove either the upper retaining nut or the two retaining bolts from the upper mounting bracket.

F. Remove the retaining nut on the lower end of the shock absorber while holding the hex head bolt with a backup wrench.

G. Remove the shock absorber.

H. Put new shock absorber in place.



I. Install the retaining unit on two retaining bolts in the top mounting bracket.

(NOTE: Check to see if grommets are properly installed.)

J. Torque the retaining nut or bolt to 12 foot-pounds pressure.

(NOTE: Torque settings may vary, so check the auto manual for exact settings.)

K. Extend the shock absorber to the length required for bolt alignment.

L. Install bolt in lower bracket and shock absorber.

M. Install lock washer and retaining nut.

N. Torque nut to 65 foot-pounds pressure.

(NOTE: Torque settings may vary, so check the auto manual for exact settings.)

O. Connect air line if air shocks are installed.

P. Remove jack stands.

Q. Lower the car to the floor.

R. Clean work area and turn in tools.

UNIT XII

FRAME, SUSPENSION, AND STEERING

JOB SHEET #3--REMOVE AND REPLACE LOWER BALL JOINT

I. Tools, equipment, and materials required

- A. 3/8" portable electric drill
- B. 1/8" and 3/8" drill bits
- C. Ball peen hammer
- D. Chisel
- E. Pin punch
- F. Center punch
- G. Safety glasses
- H. Hydraulic floor jack
- I. Two jack stands
- J. Needle nose pliers
- K. Cotter pins
- L. 3/8" drive socket set
- M. Hand grease gun
- N. Pry bar
- O. Box-end wrench set
- P. Rubber mallet
- Q. Lug wrench
- R. Ball joint remover

II. Procedure

(NOTE: Follow all safety rules.)

- A. Raise the front of car enough to place jack stands.
- B. Place jack stands in a secure position.

C. Remove front wheel covers.

D. Remove front wheels.

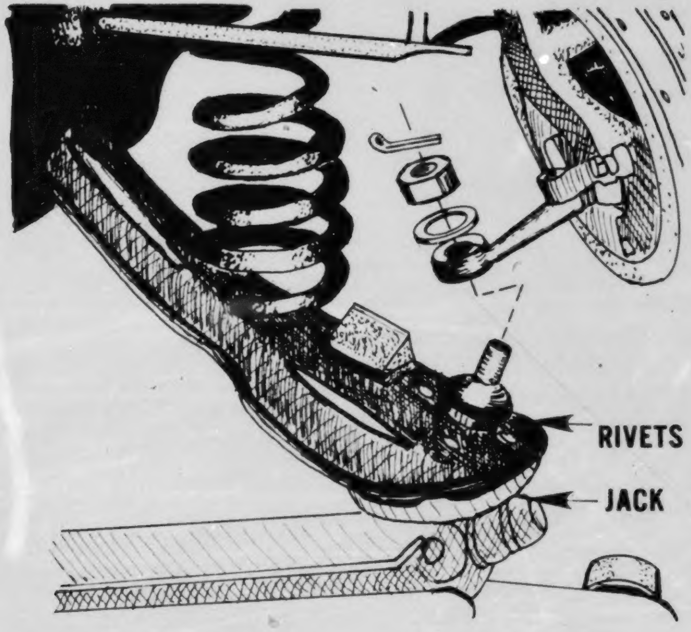
E. Center punch the center of the rivet heads on the lower ball joint.

F. Drill a 1/8" hole through the rivet heads.

G. Drill a 3/8" hole in the pilot hole of the rivet heads.

H. Knock off the rivet heads with a chisel.

I. Remove the cotter pin from the ball joint stud bolt.



J. Remove the nut from the ball joint stud bolt.

(CAUTION: Make sure the lower control arm is secured to prevent it from slamming downward when disconnected.)

K. Drive out the rivets.

L. Remove the ball joint from the steering knuckle using a ball joint remover.

M. Remove the ball joint from the lower control arm.

N. Clean lower arm and steering knuckle of dirt and grease.

O. Install a new ball joint in the upper control arm.

(NOTE: Use new bolts supplied with ball joint to secure ball joint to control arm.)

P. Align the new ball joint stud with the steering knuckle hole.

Q. Replace the stud nut and tighten.

R. Align the stud nut slot with the stud's cotter pin hole.

S. Install a new cotter pin and spread ends of pin.

T. Grease the ball joint.

U. Replace the wheel and wheel cover.

V. Remove the jack stands.

W. Lower the car to the floor.

X. Clean work area and turn in tools.

UNIT XII

FRAME, SUSPENSION, AND STEERING

JOB SHEET #4 - REMOVE AND REPLACE UPPER BALL JOINT

I. Tools, equipment, and materials required

A. 3/8" portable electric drill

B. 1/8" and 3/8" drill bits

C. Ball peen hammer

D. Chisel

E. Pin punch

F. Center punch

G. Safety glasses

H. Hydraulic floor jack

I. Two jack stands

J. Needle nose pliers

K. Cotter pins

L. 3/8" drive socket set

M. Hand grease gun

N. Pry Bar

O. Box-end wrench set

P. Rubber mallet

Q. Lug wrench

R. Ball joint remover

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise the front of the car enough to place jack stands.

B. Place jack stands in a secure position.

(NOTE: The wheels will need to be free to work around and move.)

C. Remove front wheel cover.

D. Remove front wheel.

E. Center punch rivet heads.

F. Drill a 1/8" hole through the rivet heads.

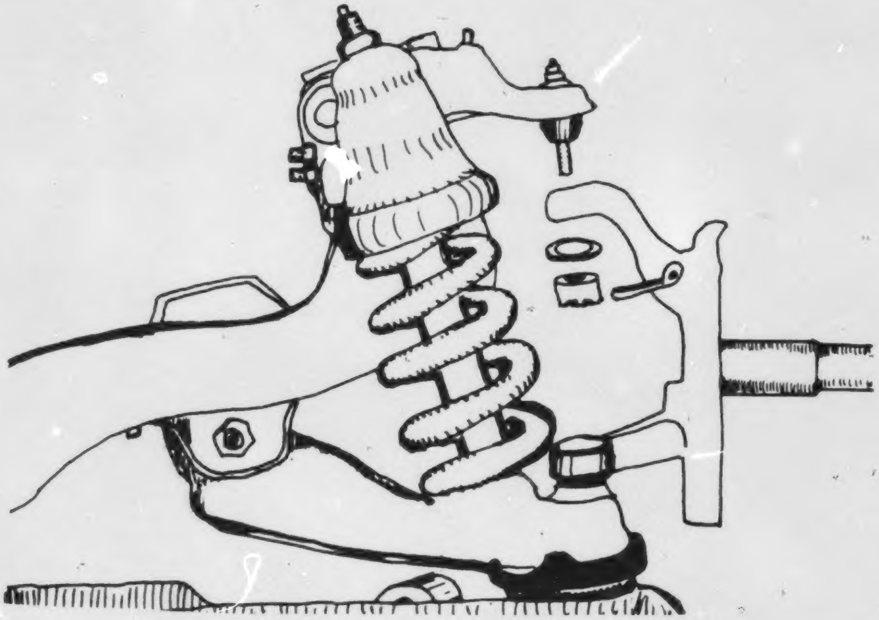
G. Drill a 3/8" hole in the pilot hole of the rivet heads.

H. Knock off the rivet heads with a chisel.

I. Remove the cotter pin from the ball joint stud bolt.

J. Remove the ball joint stud nut.

(CAUTION: Make sure the lower control arm is secured to prevent it from slamming downward when disconnected.)



K. Drive out the rivets with the pin punch.

L. Remove the ball joint from the steering knuckle using a ball joint remover.

M. Remove the ball joint from the upper control arm.

N. Clean the upper control arm and steering knuckle from dirt and grease.

O. Install a new ball joint in the lower control arm.

(NOTE: Use new bolts supplied with ball joint to secure ball joint to control arm.)

P. Align the ball joint stud bolt with the steering knuckle hole.

Q. Replace the stud nut and tighten.

R. Align the stud nut slot with the stud's cotter pin hole.

S. Install a new cotter pin and spread ends of pin.

T. Grease the ball joint.

U. Replace the wheel and wheel cover.

V. Remove jack stands.

W. Lower the car to the floor.

X. Clean work area and turn in tools.

UNIT XII

FRAME, SUSPENSION, AND STEERING

JOB SHEET #5 - REMOVE AND REPLACE TIE ROD END

I. Tools, equipment, and materials required

- A. Ball peen hammer
- B. Hydraulic floor jack
- C. Two jack stands
- D. Needle nose pliers
- E. Safety glasses
- F. 3/8" dirve socket set
- G. Pry bar
- H. Box-end wrench set
- I. Cotter pins
- J. Pipe wrench
- K. Lug wrench
- L. Liquid wrench
- M. Rubber mallet
- N. Tie rod end puller

II. Procedure
(NOTE: Follow all safety rules.)

- A. Raise the front of the car enough to place jack stands.
- B. Place jack stands in a secure position.
- C. Remove front wheel cover.
- D. Remove wheel.
- E. Apply liquid wrench to tie rod end stud nut and adjuster sleeve.

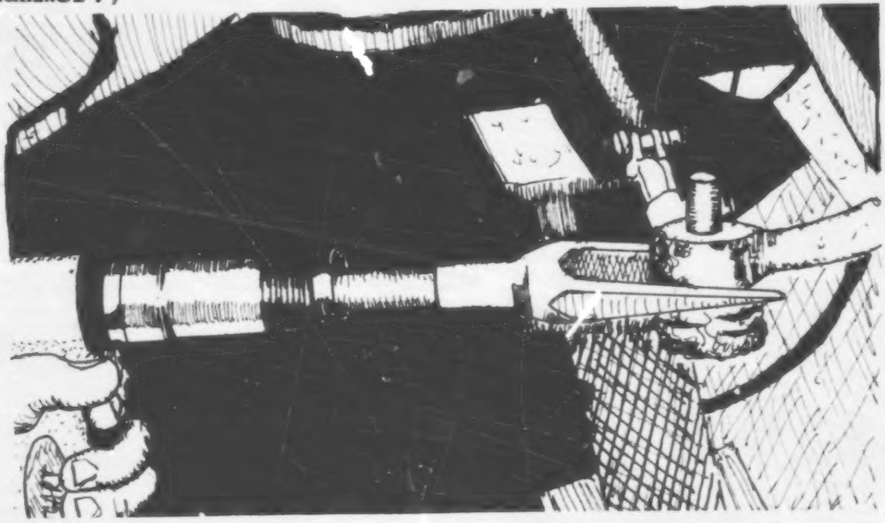
(CAUTION: Do not get liquid wrench in eyes.)

F. Loosen tie rod sleeve clamp bolt.

G. Remove the cotter pin from the tie rod end stud nut.

H. Remove tie rod end stud from the steering knuckle with tie rod end puller.

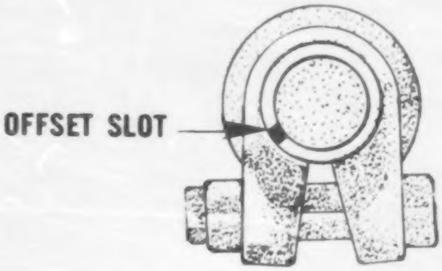
(NOTE: If a puller is not available, the tie rod stud may be removed by striking the stud with a ball peen hammer.)



I. Remove the outer tie rod end from the adjuster sleeve by turning the tie rod end counterclockwise.

(NOTE: Count the number of turns when removing the tie rod end from the sleeve.)

J. Align the clamp opening and sleeve slot properly.

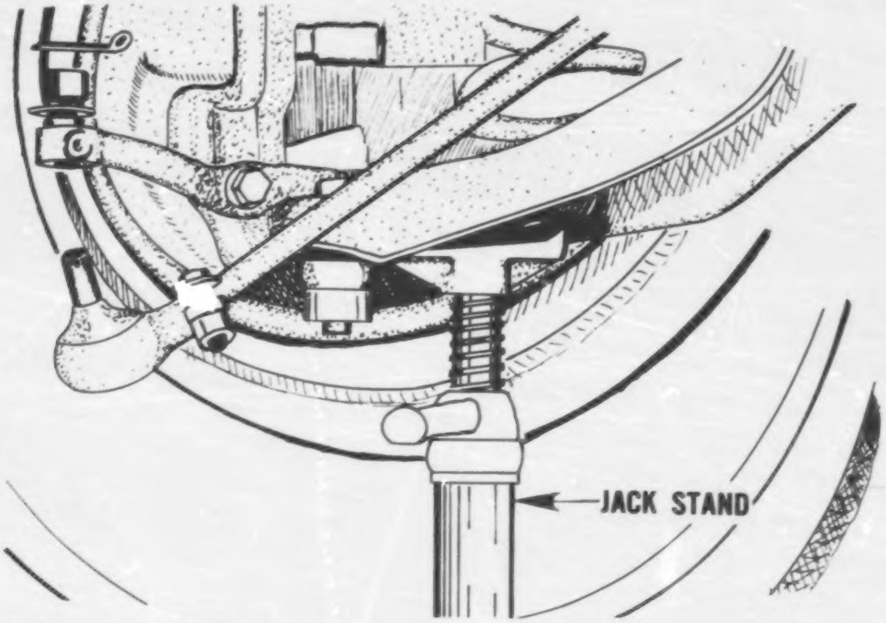


K. Install the new tie rod by turning the tie rod end clockwise the same number of turns as it took to remove the old one.

L. Align the tie rod end stud with the tapered hole of the steering knuckle arm.

M. Insert the stud in the hole.

N. Replace the tie rod end stud nut.



O. Tighten securely.

P. Align slot in stud nut with hole in the stud.

Q. Insert a new cotter pin in hole and spread ends.

R. Tighten tie rod sleeve clamp bolts.

S. Install wheel and wheel cover.

T. Remove jack stands.

U. Lower the car to the floor.

V. Clean work area and turn in tools.

(NOTE: Front-end alignment should be checked.)

UNIT XII

FRAME, SUSPENSION, AND STEERING

JOB SHEET #6 - REMOVE AND REPLACE IDLER ARM

I. Tools, equipment, and materials required

A. 3/8" dirve socket set

B. Box-end wrench set

C. Ball peen hammer

D. Hydraulic floor jack

E. Two jack stands

F. Liquid wrench

G. Torque wrench

H. Grease gun

I. Lug wrench

J. Pry bar

K. Tie rod end puller

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise the front of the car enough to place jack stands.

B. Place jack stands in a secure position.

C. Apply liquid wrench to idler arm mounting bolts and nuts.

(CAUTION: Do not get liquid wrench in eyes.)

D. Remove wheel cover

E. Remove the tire and wheel.

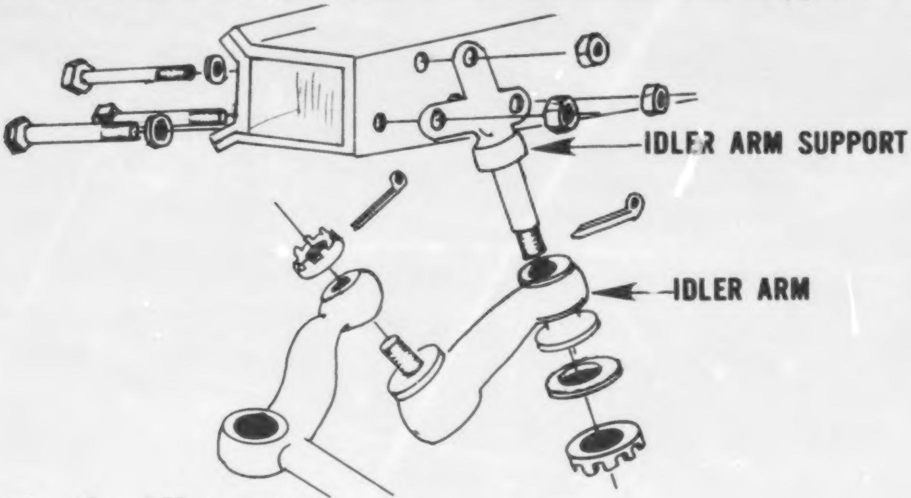
F. Remove the cotter pin from the intermediate rod stud nut holding the idler arm.

G. Remove the intermediate rod stud holding the idler arm.

H. Remove the idler arm from the intermediate rod stud with a tie rod end puller.

(NOTE: If a puller is not available, strike the idler arm near the intermediate rod to remove it.)

I. Remove the attaching bolts from the idler arm support.



J. Remove the idler arm.

K. Loosely attach the new idler arm support to the frame with new nuts and bolts.

L. Align idler arm hole with intermediate rod stud.

M. Loosely install the intermediate rod stud nut.

N. Tighten the idler arm support bolts to 40 foot-pounds pressure with the torque wrench.

O. Tighten the intermediate rod stud nut.

P. Align the slot in the nut with the hole in the stud.

Q. Insert a new cotter pin and spread ends.

R. Install wheel and wheel cover.

S. Remove the jack stands.

T. Lower the car to the floor and clean work area.

UNIT XII

FRAME, SUSPENSION, AND STEERING

UNIT TEST

1. Match the terms and definitions associated with frame, suspension, and steering.

_____a. Holds the hub assembly, upper and lower ball joints, shock absorbers, and assists in holding coil springs in place

_____b. An eyelet of rubber that protects an opening or insulates something passed through it

_____c. A tubular oil-filled device that absorbs action of the springs

_____d. A cup-shaped metal washer used to hold the grommet in place

_____e. A piece of metal that extends from the frame at the location of each spring assembly to hold one end of the shock absorber.

_____f. A shaft extending from the frame to hold one end of the shock absorber

_____g. The mounting of upper and lower ball joints, brake backing plate, front wheel hub, and tie rod ends

_____h. Brackets used for mounting leaf springs to the frame

_____i. An L-shaped rod that mounts to the frame and the intermediate rod that helps support the steering linkage

_____j. The center link of the steering linkage

1. Grommet
2. Strut shaft
3. Control arms
4. Upper mounting bracket
5. Shock absorbers
6. Retainer cup
7. Shackle
8. Intermediate rod
9. Stud
10. Coil Spring
11. Spindle assembly
12. Ball joint
13. Idler arm
14. Stabilizer
15. Steering gear
16. Leaf spring
17. Steering column

_____ k. A flexible joint with a ball-and-socket type of construction that is used in steering linkage

_____ l. A straight or tapered metal rod with threads on either or both ends

_____ m. A springy steel bar mounted to the frame and lower control arm to control body sway and leaning when cornering

_____ n. A spiral-wound spring used on front and rear suspensions

_____ o. A flat spring-steel suspension spring made of one or more pieces and used mainly on the rear axle assembly

_____ p. A gear box located on the end of the steering column that contains the gears necessary to multiply the turning force

_____ q. A tubular housing mounted to the dash that contains a steering gear shaft to which the steering wheel is mounted

1. Grommet
2. Strut shaft
3. Control arms
4. Upper mounting bracket
5. Shock absorbers
6. Retainer cup
7. Shackle
8. Intermediate rod
9. Stud
10. Coil Spring
11. Spindle assembly
12. Ball joint
13. Idler arm
14. Stabilizer
15. Steering gear
16. Leaf spring
17. Steering column

2. Identify the two types of frames used today as either a conventional type or an integral type.

____________________ a. The frame and body are a single unit with all sections welded together.

____________________ b. The frame is a separate part, and the body is bolted together.

3. List the two types of suspension systems.

a.

b.

4. Point out the advantages of independent suspension by placing a "✓" in front of each.

_____ a. Keeps wheels aligned

_____ b. Prevents flat tires

_____ c. Eliminates the use of shock absorbers

_____ d. Does not transfer the tipping action of the body

5. Identify the components of the front suspension from the list.

lower ball joint

coil spring

lower control arm

shock absorber

upper control arm

upper ball joint

steering knuckle

a.

b.

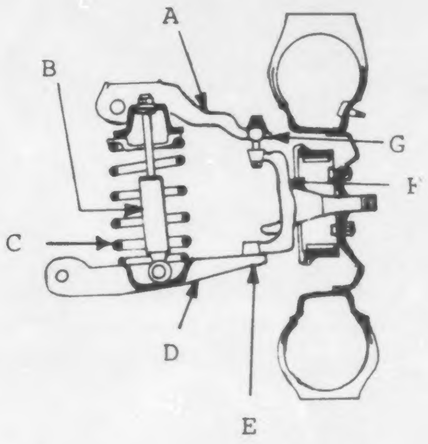
c.

d.

e.

f.

g.



6. Identify the components of the steering linkage from the list.

tie rod	idler arm
pitman arm	idler arm support
intermediate rod	steering arm

a.

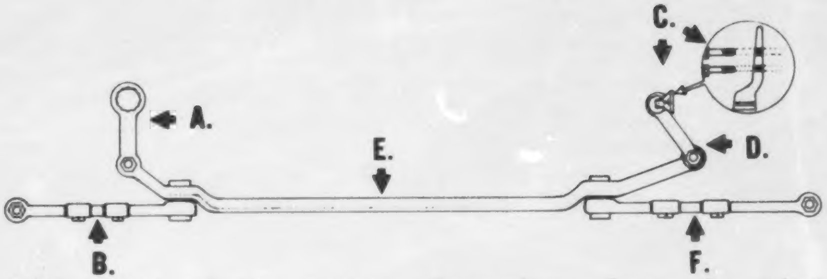
b.

c.

d.

e.

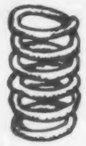
f.



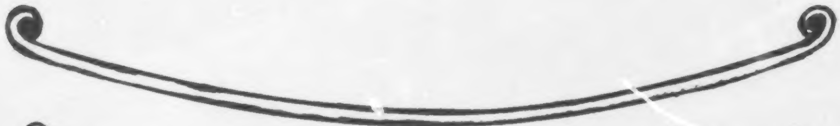
7. Identify each of the types of springs from the list.

multi-leaf spring	coil spring
single leaf spring	torsion bar spring

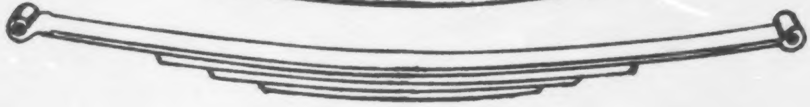
a.



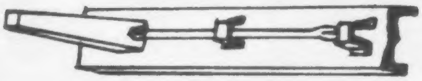
b.



c.



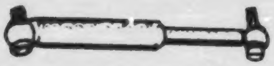
d.



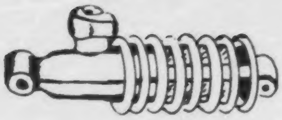
8. Identify each of the types of shock absorbers from the list.

superlift	adjustable
telescopic	

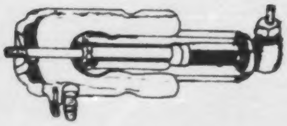
a.



b.



c.



9. Demonstrate the ability to:

   a. Remove and replace front shock absorber.

   b. Remove and replace rear shock absorber.

   c. Remove and replace lower ball joint.

   d. Remove and replace upper ball joint

   e. Remove and replace tie rod ends.

   f. Remove and replace idler arm.

   (NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT XII

FRAME, SUSPENSION, AND STEERING

ANSWERS TO TEST

1. ___3___ a.
   ___1___ b.
   ___5___ c.
   ___6___ d.
   ___4___ e.
   ___2___ f.
   ___11___ g.
   ___7___ h.
   ___13___ i.
   ___8___ j.
   ___12___ k.
   ___9___ l.
   ___14___ m.
   ___10___ n.
   ___16___ o.
   ___15___ p.
   ___17___ q.

2. ___integral type___ a.
   ___conventional___ b.

3. a. Solid axle leaf spring suspension
   b. Independent coil spring suspension

4. ___✓___ a.
   ______ b.

_____ c.

__✓__ d.

5. a. Upper control arm
   b. Shock absorber
   c. Coil Spring
   d. Lower control arm
   e. Lower ball joint
   f. Steering knuckle
   g. Upper ball joint

6. a. Steering arm
   b. Tie rod
   c. Idler arm support
   d. Idler arm
   e. Intermediate rod
   f. Pitman arm

7. a. Coil spring
   b. Single leaf spring
   c. Multi-leaf spring
   d. Torsion bar spring

8. a. Telescopic
   b. Adjustable
   c. Super lift

9. Evaluated to the satisfaction of the instructor.

UNIT XIII

DRIVE LINE

UNIT OBJECTIVE

After completion of this unit, the student will be able to identify, adjust, and replace parts of the drive line. The student will be able to explain the ratio of the different gears of a standard transmission. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with drive lines.
2. Identify the components of the drive line.
3. Identify the components of the clutch assembly.
4. Explain the ratio of standard transmission gears.
5. Demonstrate the ability to:
    a. Remove and replace speedometer drive gear.
    b. Remove and replace drive shaft.
    c. Remove and replace universal joint cross and roller bearings.
    d. Adjust clutch travel.
    e. Remove and replace transmission support.
    f. Replace rear transmission seal.
    g. Remove and replace rear axle bearing.

UNIT XIII

DRIVE LINE

SUGGESTED ACTIVITIES

I. Instructor

  A. Provide student with objective sheet.

  B. Provide student with information and job sheets.

  C. Make transparencies.

  D. Discuss unit and specific objectives.

  E. Discuss information and job sheets.

  F. Demonstrate the procedures outlined in the job sheets.

  G. Give test.

II. Student

  A. Read objective sheet.

  B. Study information sheet.

  C. Complete job sheets.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM-1--Drive Line

    2. TM-2--Transmission Gear Ratios

    3. TM-3--Clutch Assembly

    4. TM-4--Propeller Shaft

5. TM-5--Universal Joint
6. TM-6--Differential

D. Job sheets

1. Job Sheet #1--Remove and Replace Speedometer Drive Gear
2. Job Sheet #2--Remove and Replace Drive Shaft
3. Job Sheet #3--Remove and Replace Universal Joint Cross and Roller Bearing
4. Job Sheet #4--Adjust Clutch Travel
5. Job Sheet #5--Remove and Replace Transmission Support
6. Job Sheet #6--Replace Transmission Seal
7. Job Sheet #7--Remove and Replace Rear Axle Bearing

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. *Auto Mechanics Fundamentals*. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1974.

B. Stockel, Martin W. *Auto Service and Repair*. South Holland, Illinois: The Goodheart-Wilcox Company, Inc., 1975.

UNIT XIII

DRIVE LINE

INFORMATION SHEET

I. Terms and definitions

  A. Propeller (drive) shaft--A tube, with flexible joints at each end, that connects the transmission and the differential

  B. Universal joints--An x-shaped unit that allows flexibility in the shaft between the transmission and differential

  C. Differential--The last unit of the power train that allows for the different speeds of the rear wheels when turning a corner

  D. Standard transmission--A unit in the power train used with a clutching system that allows the operator to select various gears by manually shifting

  E. Clutch disc--A spring-loaded metal plate with a fiber coating that absorbs the shock of engine torque

  F. Pressure plate--A metal disc bolted directly to the flywheel that puts pressure on the clutch disc, putting the vehicle in motion

  G. Clutch throw-out fork--A forked device that holds the throw-out bearing in place and is connected to the clutch pedal linkage

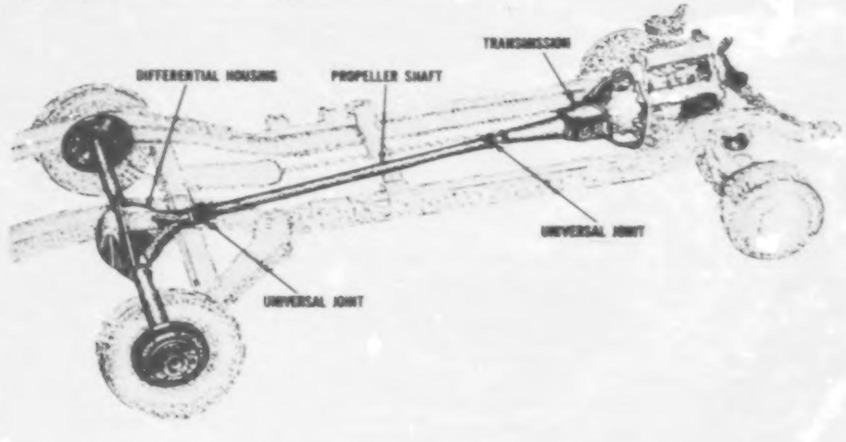
  H. Throw-out bearing--A bearing used to depress the pressure plate fingers which engages the clutch disc

  I. Clutch linkage--An adjustable metal rod located between the clutch pedal and clutch throw-out fork

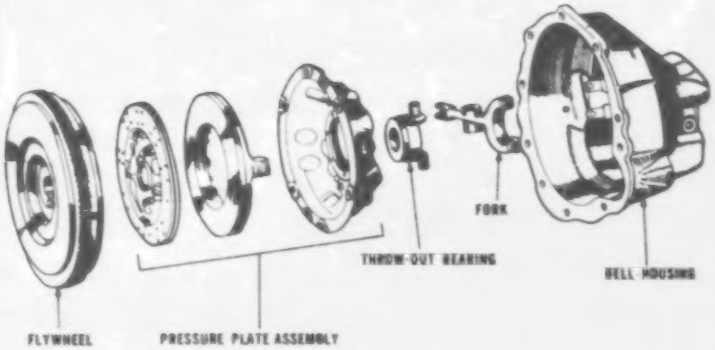
  J. Clutch pedal--A device located inside the vehicle next to the steering column which allows the driver to engage or disengage the clutch

  K. Rear axles--Shafts that transfer the power from the differential to the rear wheels

II. Components of the power train


TRANSMISSION
DIFFERENTIAL HOUSING
PROPELLER SHAFT
UNIVERSAL JOINT
UNIVERSAL JOINT

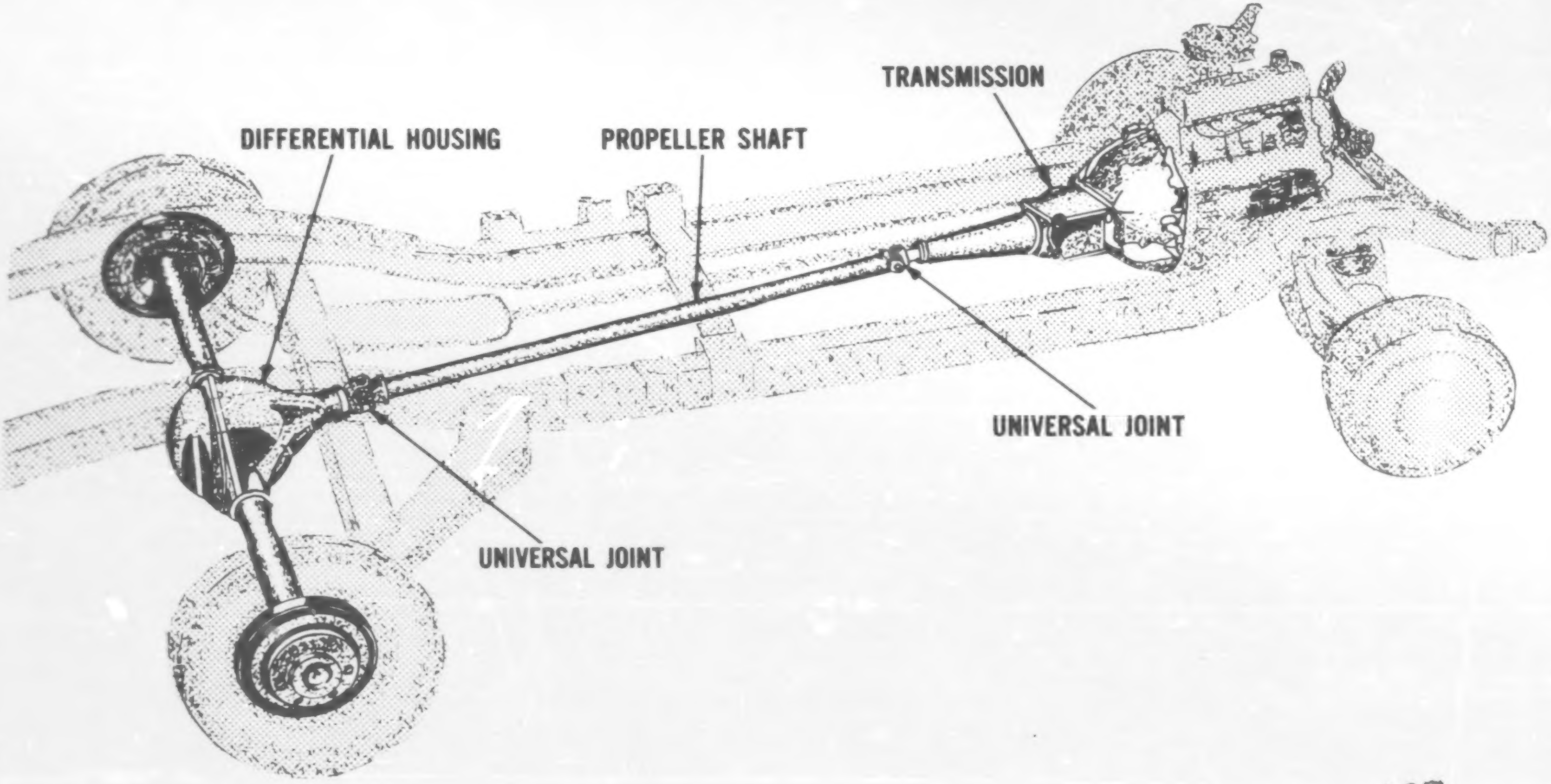
III. Components of a clutch assembly


FORK
THROW-OUT BEARING
BELL HOUSING
FLYWHEEL
PRESSURE PLATE ASSEMBLY

IV. Standard transmission gear ratios

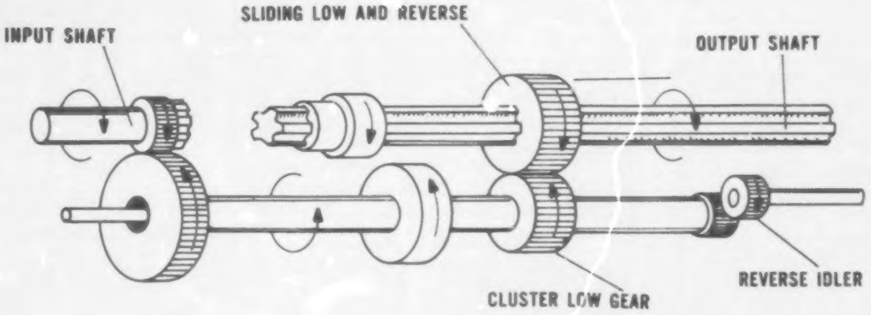
Gear	Engine revolutions	Driveshaft revolutions
First	3	1
Second	2	1
Third	1	1
Reverse	3.5	1

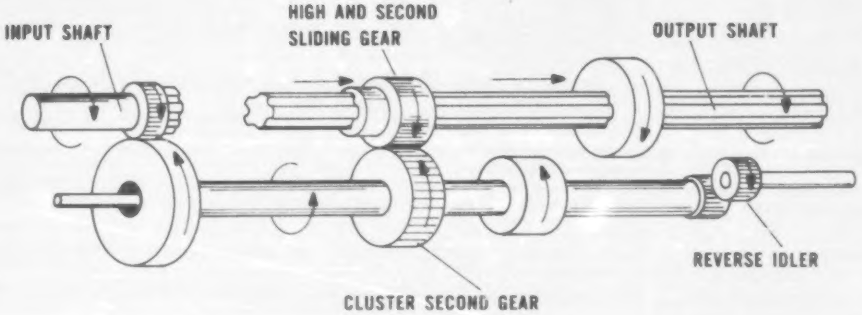
DRIVE LINE

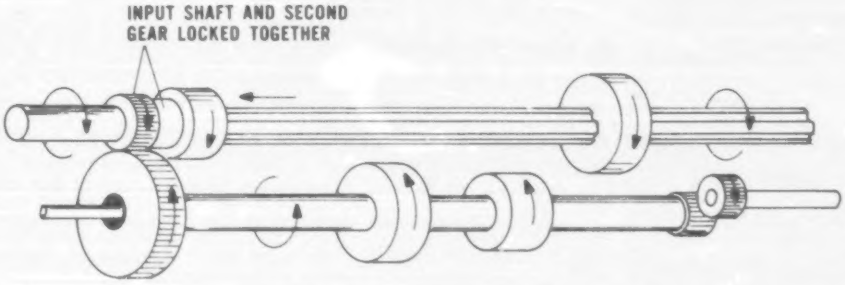

TRANSMISSION
DIFFERENTIAL HOUSING
PROPELLER SHAFT
UNIVERSAL JOINT
UNIVERSAL JOINT

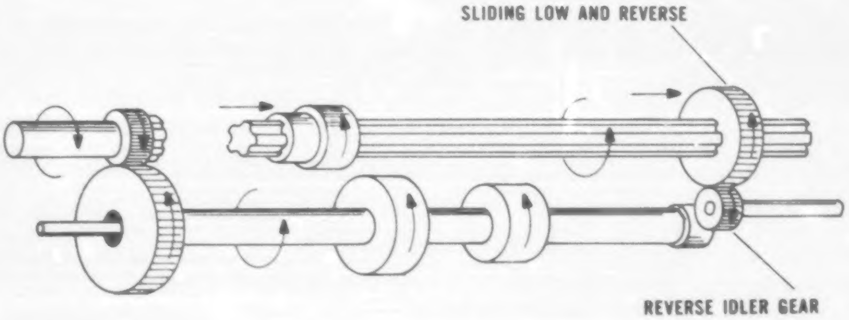
467

TRANSMISSION GEAR RATIOS

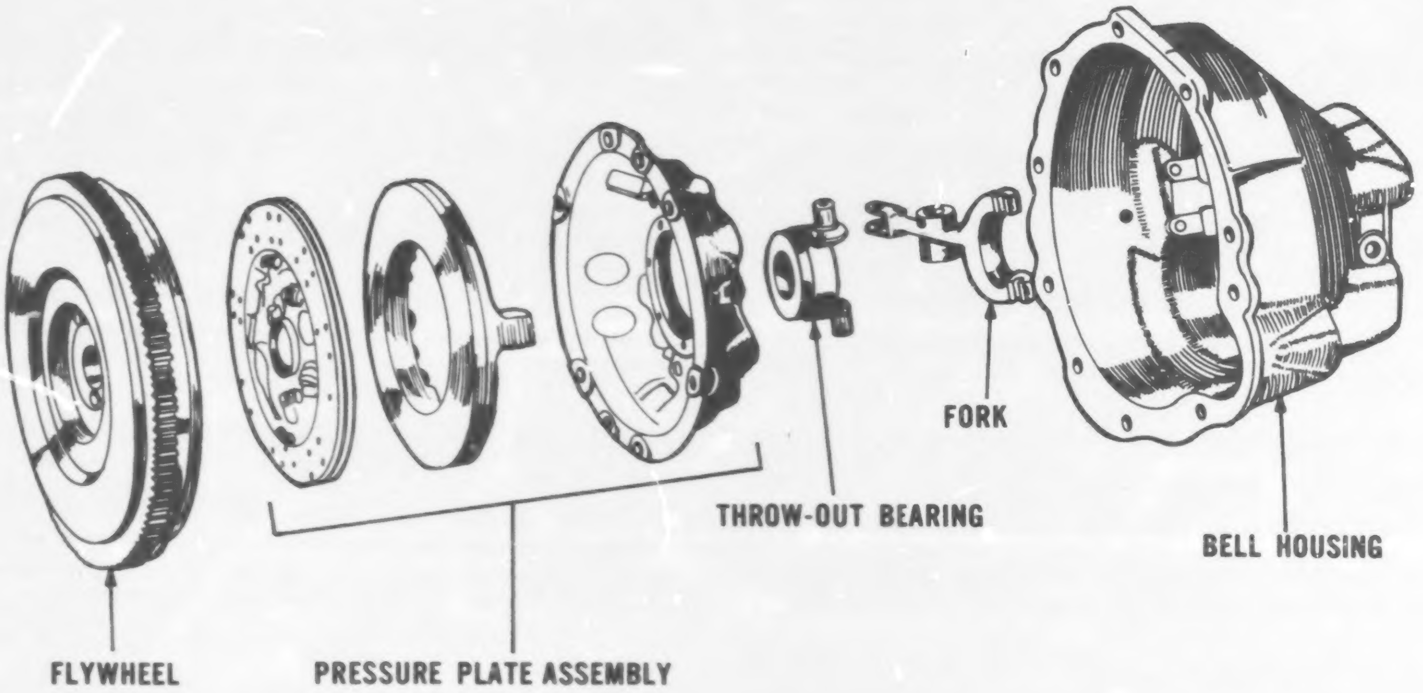

INPUT SHAFT
SLIDING LOW AND REVERSE
OUTPUT SHAFT
REVERSE IDLER
CLUSTER LOW GEAR


INPUT SHAFT
HIGH AND SECOND
SLIDING GEAR
OUTPUT SHAFT
REVERSE IDLER
CLUSTER SECOND GEAR

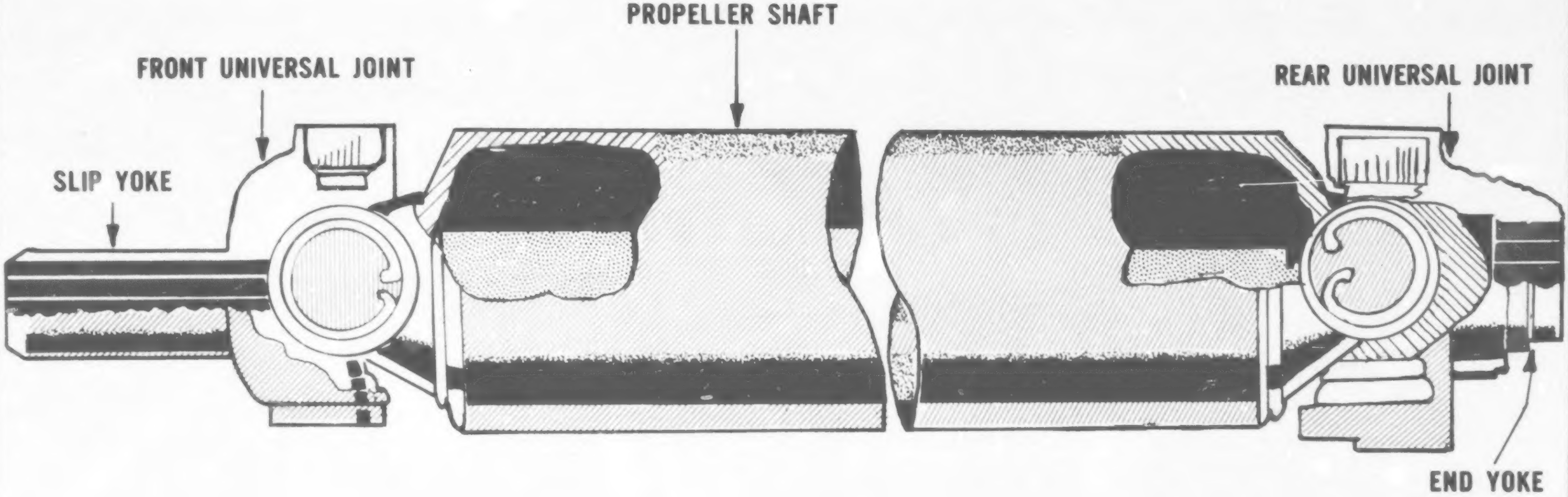

INPUT SHAFT AND SECOND
GEAR LOCKED TOGETHER


SLIDING LOW AND REVERSE
REVERSE IDLER GEAR

CLUTCH ASSEMBLY


FORK
THROW-OUT BEARING
BELL HOUSING
FLYWHEEL
PRESSURE PLATE ASSEMBLY

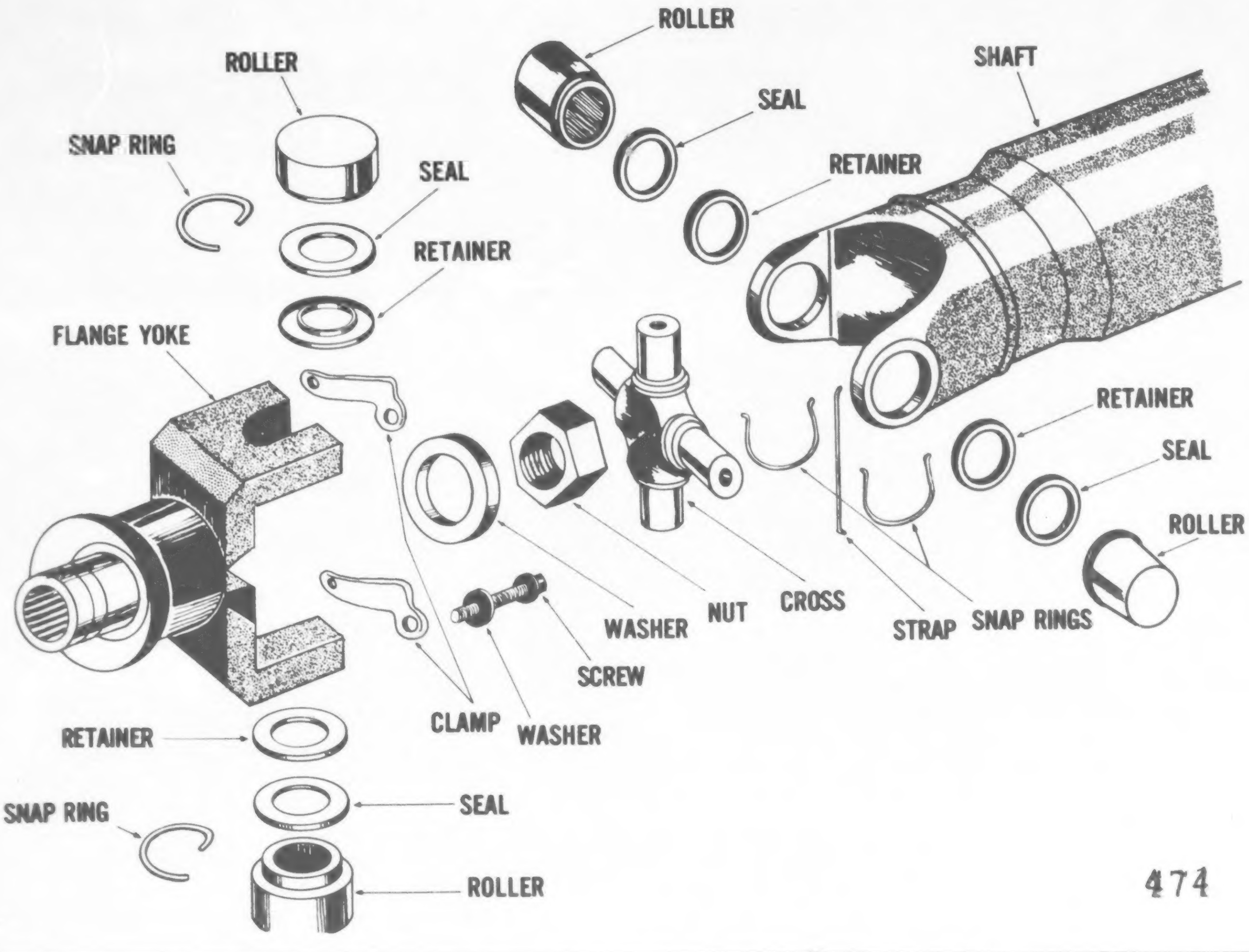
PROPELLER SHAFT


PROPELLER SHAFT
FRONT UNIVERSAL JOINT
REAR UNIVERSAL JOINT
SLIP YOKE
END YOKE

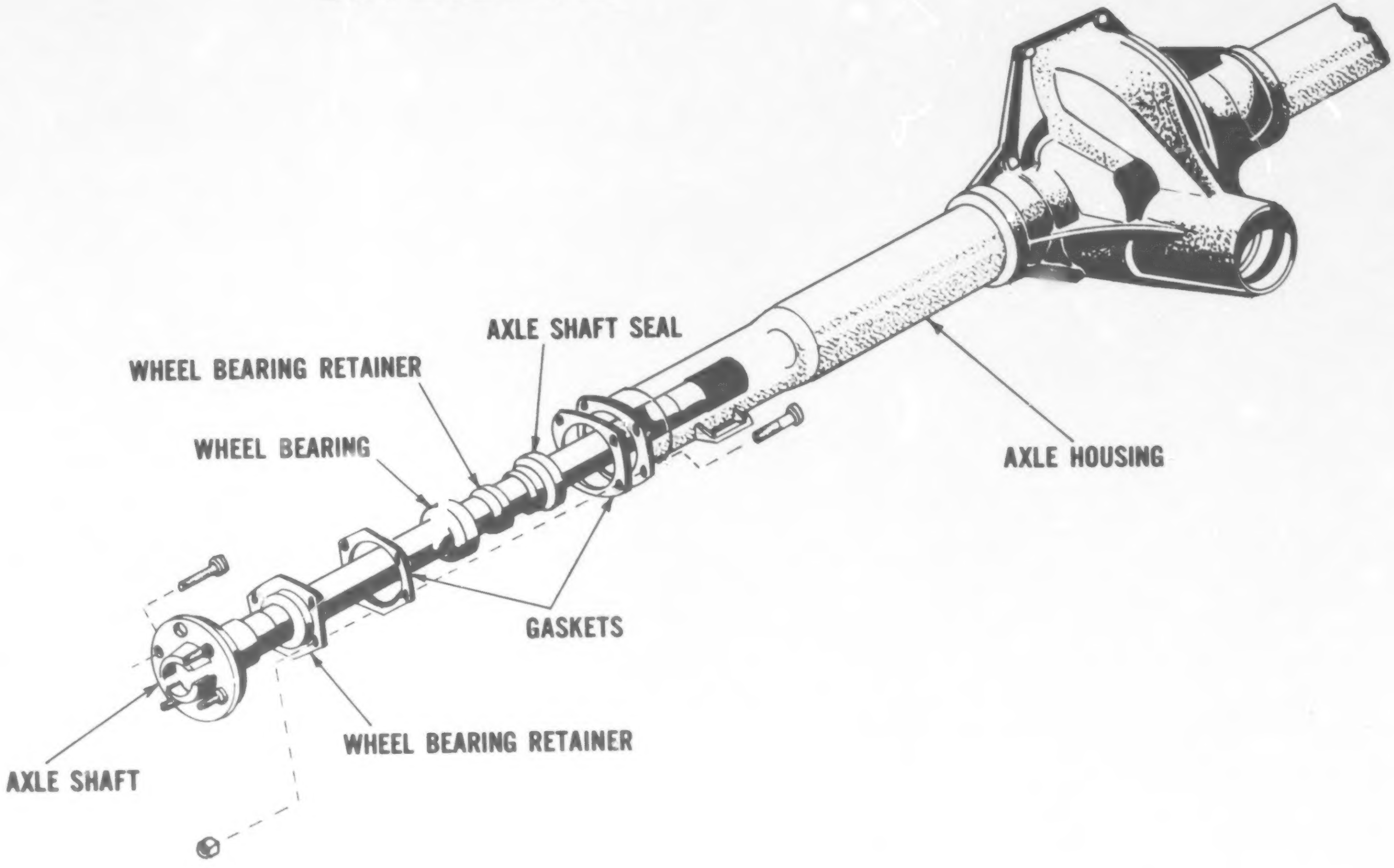
472

471

UNIVERSAL JOINT


ROLLER
ROLLER
SHAFT
SEAL
SNAP RING
SEAL
RETAINER
RETAINER
FLANGE YOKE
RETAINER
SEAL
ROLLER
WASHER
NUT
CROSS
STRAP
SNAP RINGS
SCREW
CLAMP
WASHER
RETAINER
SEAL
SNAP RING
ROLLER

DIFFERENTIAL


AXLE SHAFT SEAL
WHEEL BEARING RETAINER
WHEEL BEARING
AXLE HOUSING
GASKETS
AXLE SHAFT
WHEEL BEARING RETAINER

UNIT XIII

DRIVE LINE

JOB SHEET #1--REMOVE AND REPLACE SPEEDOMETER DRIVE GEAR

I. Tools, equipment, and materials required

  A. Common pliers

  B. Snap ring pliers

  C. 3/8" drive socket set

  D. Hydraulic floor jack

  E. Two jack stands

  F. Creeper

II. Procedure

  (Note: Follow all safety rules.)

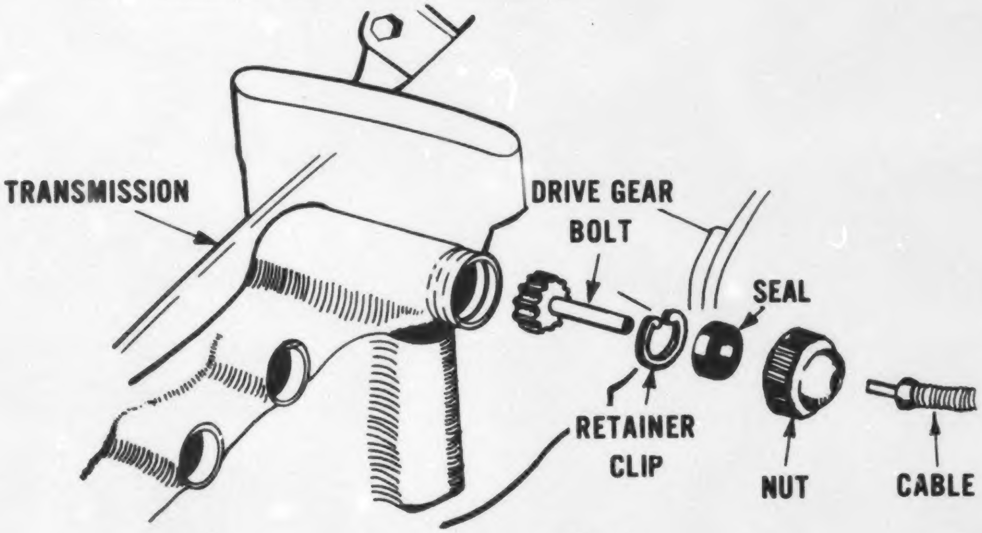
  A. Raise front of car enough to place jack stands.

  B. Place jack stands in a secure position.

  C. Locate the speedometer cable where it enters the transmission.

  D. Loosen the flange nut by turning it counterclockwise on the cable housing with the pliers.

  E. Remove the cable housing.



F. Remove the bolt holding the drive gear into the transmission housing using the socket set.

G. Use the snap ring pliers to remove the snap spring holding the plastic gear in place.

H. Install the new gear in the transmission housing.

I. Replace the snap spring in the housing.

J. Replace the bolt holding the drive gear in the transmission housing.

K. Tighten the bolt securely.

L. Replace the cable housing.

M. Tighten with common pliers.

N. Remove jack stands.

O. Lower car to the floor.

P. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

JOB SHEET #2--REMOVE AND REPLACE DRIVE SHAFT

I. Tools, equipment, and materials required

- A. 3/8" drive socket set
- B. Open-end wrench set
- C. Hydraulic floor jack
- D. Two jack stands
- E. Masking tape

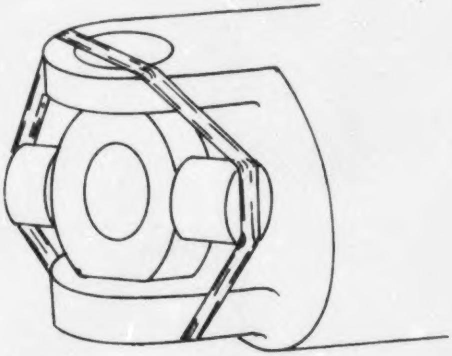
II. Procedure

(Note: Follow all safety rules.)

- A. Raise rear of car enough to place jack stands.
- B. Place jack stands in a secure position.
- C. Using a 7/16" x 1/2" open-end wrench, remove nuts from the U-bolts at the rear of the drive shaft.
- D. Remove the U-bolts.

  (Caution: Hold the roller caps in place to prevent the bearings dropping out.)

- E. Tape the roller caps to the cross of the universal joint.



F. Pull drive shaft to rear of car to remove the shaft from the transmission spline.

(Note: If universal joint needs to be replaced, go to Job Sheet #3.)

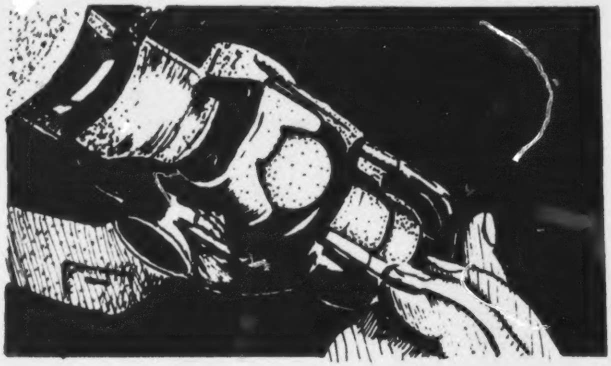
G. Slide new or repaired drive shaft onto transmission spline.

H. Remove tape from rear of drive shaft.

(Caution: Do not pull roller caps from cross.)

I. Place rear of drive shaft in place on differential.

J. Install U-bolts to hold rear of drive shaft.



K. Place lockwashers and nuts on U-bolts.

L. Tighten nuts securely.

M. Remove jack stands.

N. Lower car to the floor.

O. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

JOB SHEET #3--REMOVE AND REPLACE UNIVERSAL JOINT CROSS AND ROLLER BEARINGS

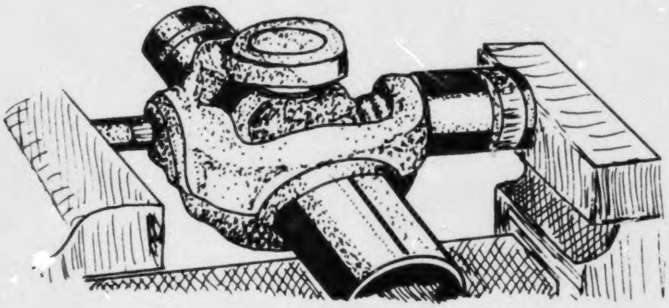
I. Tools, equipment, and materials required

- A. Needle nose pliers
- B. Common 6" screwdriver
- C. 1/2" drive socket set
- D. Bench vise
- E. Ball peen hammer
- F. Grease gun

II. Procedure

(Note: Follow all safety rules.)

- A. Determine which universal joint needs the parts replaced.
- B. Remove the snap rings on the outside of each roller bearing with needle nose pliers and a screwdriver.
- C. Place the universal joint in a vise with a 1 1/8" socket over one roller bearing and a 9/16" socket on the other bearing.



D. Tighten vise to press roller bearing free from yoke.

(CAUTION: Keep sockets in line to prevent damage to the yoke or cross.)

E. Release the vise and remove the loose bearing.

F. Place the sockets on opposite ends of the yoke.

G. Loosen the vise and remove the bearing.

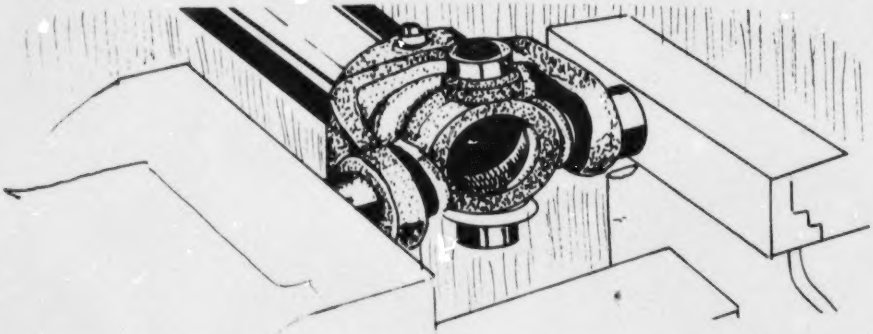
H. Remove the cross by tilting it to one side.

I. Grease new roller bearings.

J. Place new cross in yoke.

K. Install new roller bearings in each side of the yoke.

L. Carefully press bearings onto the cross as they are pressed into the yoke.



M. Use a small socket to press each bearing past the snap ring grooves.

N. Insert snap rings in the grooves.

O. Check the cross for freedom of movement.

P. Grease the grease fitting on the new cross with a grease gun.

Q. Follow the procedures on Job Sheet #2, if the propeller shaft is to be installed.

R. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

JOB SHEET #4 -- ADJUST CLUTCH TRAVEL

I. Tools, equipment, and materials required

   A. Hydraulic floor jack

   B. 3/8" drive socket set

   C. Open-end wrench set

   D. Two jack stands

   E. Creeper

II. Procedure

   (NOTE: Follow all safety rules.)

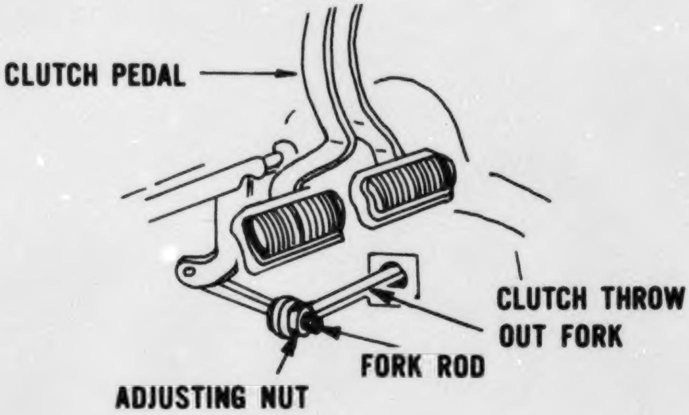
   A. Raise the front of the car enough to place jackstands.

   B. Place jack stands in a secure position.

   C. Locate the clutch throw-out fork adjusting nut.

   (NOTE: The clutch fork can be located on the side of the bell housing.)

   D. Loosen the lock nut with the proper size wrench, if the fork rod has a lock nut.



E. Adjust the fork adjustment nut so that the clutch throw-out fork moves toward the rear of the car.

F. Push the clutch pedal down frequently by hand to check for proper clutch travel.

(NOTE: There should be approximately 2 inches of free travel before the throw-out bearing strikes the pressure plate fingers and more pressure is required on the clutch pedal.)

G. Secure lock nut when the clutch is properly adjusted.

H. Remove jack stands.

I. Lower the car to the floor.

J. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

JOB SHEET #5--REMOVE AND REPLACE TRANSMISSION SUPPORT

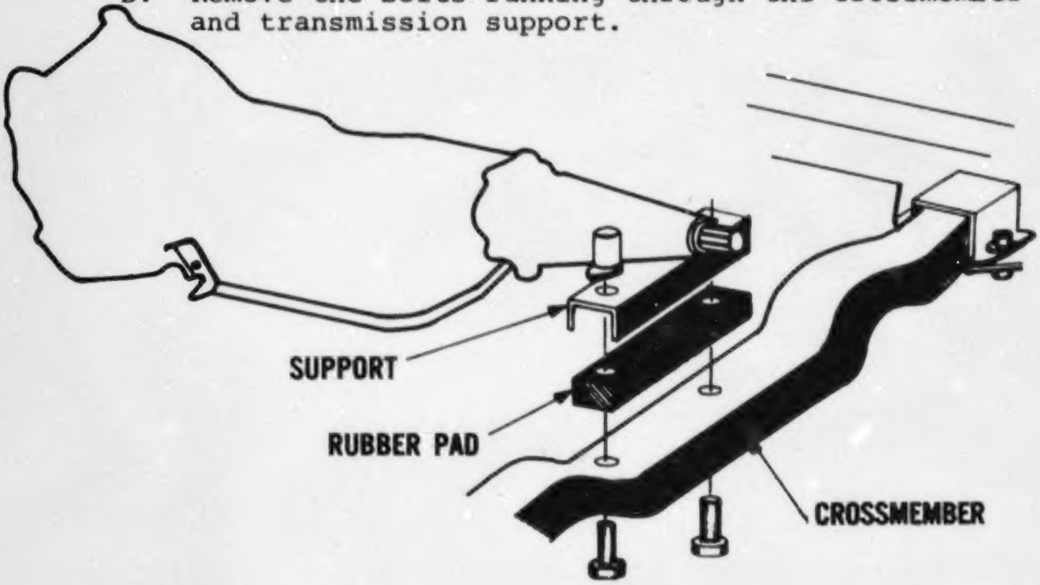
I. Tools, equipment, and materials required

- A. Hydraulic floor jack
- B. Two jack stands
- C. 3/8" socket set
- D. Creeper
- E. New transmission support

II. Procedure

(NOTE: Follow all safety rules.)

- A. Raise the front of the car enough to place jack stands.
- B. Place jack stands in a secure position.
- C. Locate the rear transmission support on top of the crossmember and to the rear of the transmission.
- D. Remove the bolts running through the crossmember and transmission support.



E. Place jack under transmission.

F. Raise transmission about 3 inches to free the support.

G. Remove the rubber support.

H. Align bolt holes in support and crossmember.

I. Lower transmission to the support.

J. Replace bolts in crossmember and support.

K. Tighten securely.

L. Remove jack stands.

M. Lower car to the floor.

N. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

JOB SHEET #6-- REPLACE REAR TRANSMISSION SEAL

I. Tools, equipment, and materials required

A. Hydraulic floor jack

B. Two jack stands

C. Creeper

D. Open-end wrench

E. Rubber mallet

F. 8" common screwdriver

G. 3/8" drive socket set

H. Masking tape

I. Rear transmission seal

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise rear of car enough to place jack stands.

B. Place jack stands in a secure position.

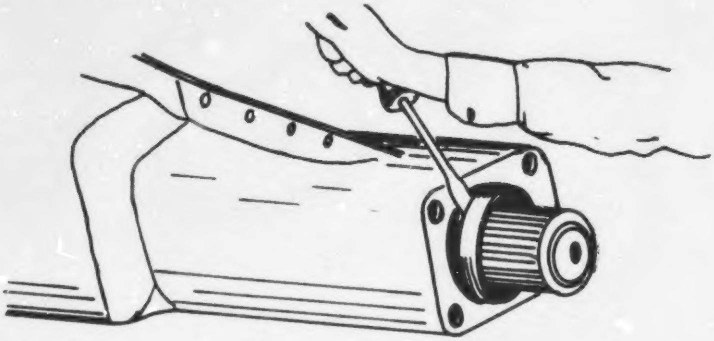
C. Remove rear universal joint U-bolts.

D. Tape the roller bearings in place with masking tape.

E. Remove drive shaft by pulling it to the rear of the car.

F. Insert screwdriver under lip of rear transmission seal and pry out.

G. Pry on seal until removed.



H. Install new seal into housing.

I. Tap gently around the seal until it is flush with the cone housing.

J. Replace drive shaft onto transmission spline.

K. Remove tape from roller bearings.

L. Place rear universal joint in place on differential yoke.

M. Replace U-bolts.

N. Tighten securely.

O. Remove jack stands.

P. Lower car to the floor.

Q. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

JOB SHEET #7 -- REMOVE AND REPLACE REAR AXLE BEARING

I. Tools, equipment, and materials required

A. 3/8" drive socket set

B. Slide hammer puller

C. Hydraulic floor jack

D. Jack stand

E. New rear axle bearing

F. Lug wrench

II. Procedure

(NOTE: Follow all safety rules.)

A. Raise the rear wheel enough to place jack stand.

B. Place jack stand in a secure position.

C. Remove hub cap.

D. Remove wheel.

E. Rotate axle flange until a bolt head appears in the hole in the axle flange.

F. Remove the retainer bolt using the correct socket with the socket wrench.

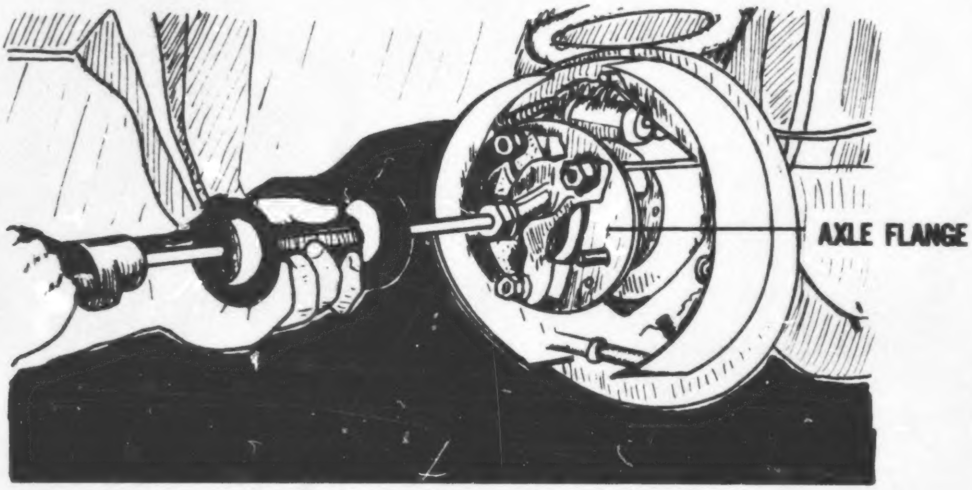
G. Remove each of the retainer bolts through the hole in the flange.

H. Connect the slide hammer to the axle flange lug bolts.

(CAUTION: Do not disrupt brake components.)

I. Remove the rear axle by using the slide hammer puller.

(CAUTION: Keep your fingers clear of the sliding hammer.)



J. Cut or press the old bearing off of the axle.

K. Press new bearing on the axle.
(Note: The grease seal should be replaced if necessary.)

L. Replace axle in differential housing.

M. Replace retainer bolts and nuts.

N. Tighten the nuts and bolts securely.

O. Replace the wheel.

P. Replace the hub cap.

Q. Remove jack stand.

R. Lower car to the floor.

S. Clean work area and turn in tools.

UNIT XIII

DRIVE LINE

UNIT TEST

1. Match the terms and definitions associated with drive lines.

_____ a. A tube with flexible joints at each end that connects the transmission and differential

_____ b. An X-Shaped unit that allows flexibility in the shaft between the transmission and differential

_____ c. The last unit of the power train that allows for the different speeds of the rear wheels when turning a corner

_____ d. A unit in the power train used with clutching system that allows the operator to select various gears by manually shifting

_____ e. A spring-loaded metal plate with a fiber coating that absorbs the shock of engine torque

_____ f. A metal disc bolted directly to the fly wheel that puts pressure on the clutch disc, putting the vehicle in motion

_____ g. A forked device that holds the throw-out bearing in place and is connected to the clutch pedal linkage

_____ h. A bearing used to depress the pressure plate fingers which engages the clutch disc

_____ i. An adjustable metal rod located between the clutch pedal and clutch throw-out fork

1. Standard transmission
2. Propeller shaft
3. Clutch disc
4. Pressure plate
5. Differential
6. Universal joint
7. Clutch throwing
8. Throw-out bearing
9. Rear axles
10. Clutch pedal
11. Clutch linkage

_____ j. A device located inside the vehicle next to the steering column which allows the driver to engage or disengage the clutch

_____ k. Shafts that transfer the power from the differential to the rear wheels

2. Identify the components of the drive line from the list below.

Transmission

Universal joint

Propeller shaft

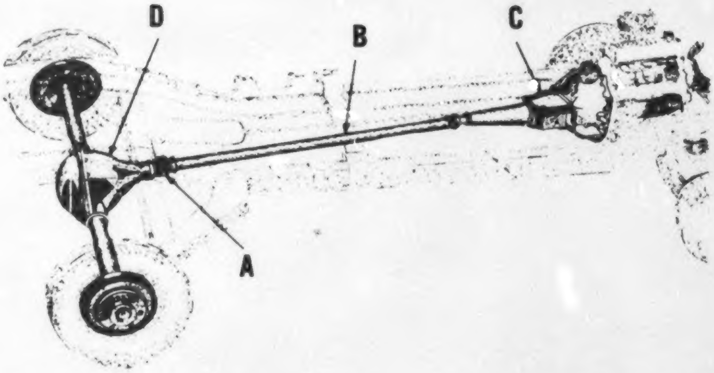
Differential

a.

b.

c.

d.



3. Identify the components of the clutch assembly from the list below.

Flywheel

Throw-out bearing

Pressure plate assembly

Bell housing

Throw-out fork

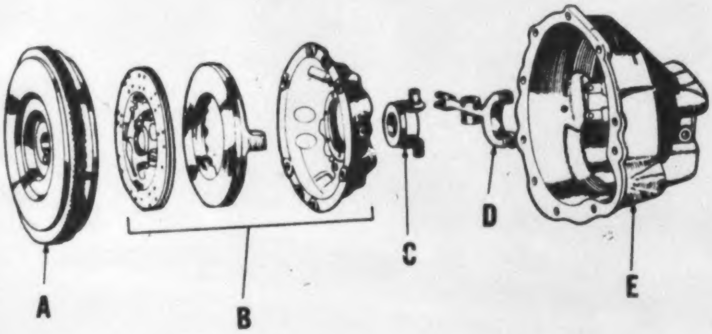
a.

b.

c.

d.

e.



4. Explain the ratio of standard transmission gears by circling the correct answer for each of the following.

    a. When the transmission is in first gear, the engine is turning (2, 3, 4) times as fast as the drive shaft.

    b. When the engine is turning twice as fast as the drive shaft, the transmission is in (first, second, third) gear.

    c. When the transmission is in third gear, the drive shaft will be turning (faster than, the same as, slower than) the engine.

    d. The gear ratio of the transmission to drive shaft when the transmission is in reverse is (1 to 1, 2 to 1, 2.5 to 1, 3.5 to 1).

5. Demonstrate the ability to:

    a. Remove and replace speedometer drive gear.

    b. Remove and replace drive shaft.

    c. Remove and replace universal joint cross and roller bearings.

    d. Adjust clutch travel.

    e. Remove and replace transmission support.

    f. Replace rear transmission seal.

    g. Remove and replace rear-axle bearing.

    (NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT XIII

DRIVE LINE

ANSWERS TO UNIT TEST

1.
   - 2 a.
   - 6 b.
   - 5 c.
   - 1 d.
   - 3 e.
   - 4 f.
   - 7 g.
   - 8 h.
   - 11 i.
   - 10 j.
   - 9 k.

2.
   - a. Universal joint
   - b. Propeller shaft
   - c. Transmission
   - d. Differential

3.
   - a. Flywheel
   - b. Pressure plate assembly
   - c. Throw-out bearing
   - d. Throw-out fork
   - e. Bell Housing

4.
   - a. 3
   - b. second
   - c. the same as
   - d. 3.5 to 1

5. Evaluated to the satisfaction of the instructor.

UNIT XIV

CLEANING THE CAR

UNIT OBJECTIVE

After completion of this unit, the student will be able to identify cleaning materials and equipment, and properly clean car parts. The student will be able to clean the interior and exterior on the car and wax the surfaces of the car. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with cleaning the car.
2. Select the correct safety rules associated with cleaning the car.
3. Identify the components of a parts washer.
4. Demonstrate the ability to:
   a. Clean parts in the parts washer.
   b. Wash the car exterior.
   c. Wax the car surface.
   d. Clean the upholstery.
   e. Vacuum the interior.

UNIT XIV

CLEANING THE CAR

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E Discuss information and job sheets.

   F. Demonstrate the procedures outlined on the job sheets.

   G. Give test.

II. Student

   A. Read objectives.

   B. Study information sheet.

   C. Complete each job sheet.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM-1--Cleaning Parts

      2. TM-2--Cleaning the car

   D. Job sheets

      1. Job Sheet #1--Clean Parts in the Parts Washer

2. Job Sheet #2--Wash the Car Exterior
3. Job Sheet #3--Wash the Car Surface
4. Job Sheet #4--Clean and Vacuum the Interior

E. Test

F. Answers to test

II. References

A. Stockel, Martin W. Auto Service and Repair.
South Holland, Illinois: The Goodheart-Wilcox
Company, Inc., 1975.

UNIT XIV

CLEANING THE CAR

INFORMATION SHEET

I. Terms and definitions

A. Solvent--A liquid used to dissolve or thin another material

B. Scraper--A wide-bladed device used in removing grease and dirt deposits

C. Parts washer--A large vat filled with solvent and equipped with a soaking tray, a solvent agitator, and a filter for cleaning the solvent used in cleaning automotive parts

D. Chamois--A thin leather skin used in removing water from windshields or the car body surfaces.

E. Fusible link--A device supporting the lid of a parts washer that will allow the lid to shut automatically in case of fire

II. Cleaning safety rules

A. Do not use gasoline as a cleaning solution.

B. Keep area well-ventilated.

C. Keep a fusible link on the parts washer.

D. Keep lids on cleaning containers when not in use.

E. Avoid getting solvent on your skin.

F. Read and follow manufacturer's instructions on all containers.

G. Wear eye and face protection when using cleaners.

H. Wear appropriate clothing, including shoes.

I. Do not point air hoses or parts sprayers toward others.

J. Never smoke around cleaning solvents or parts washers.

K. Avoid prolonged breathing of solvent vapors.

L. Always rinse parts thoroughly.

M. Clean the work area when a job is finished.

III. Components of a parts washer

A. Safety lid

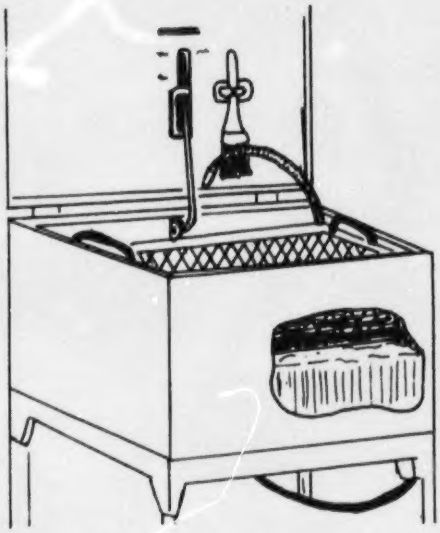
B. Fusible link

C. Parts tray

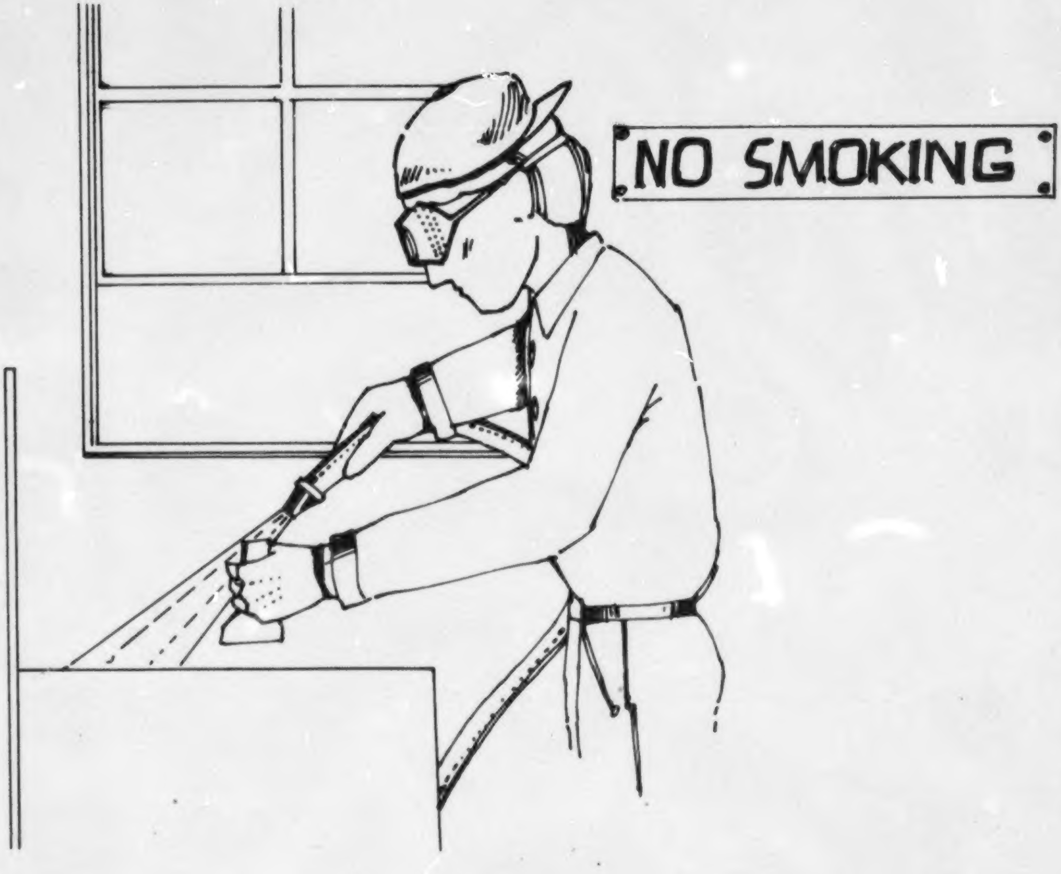
D. Flush hose

E. Soaking vat

F. Brush

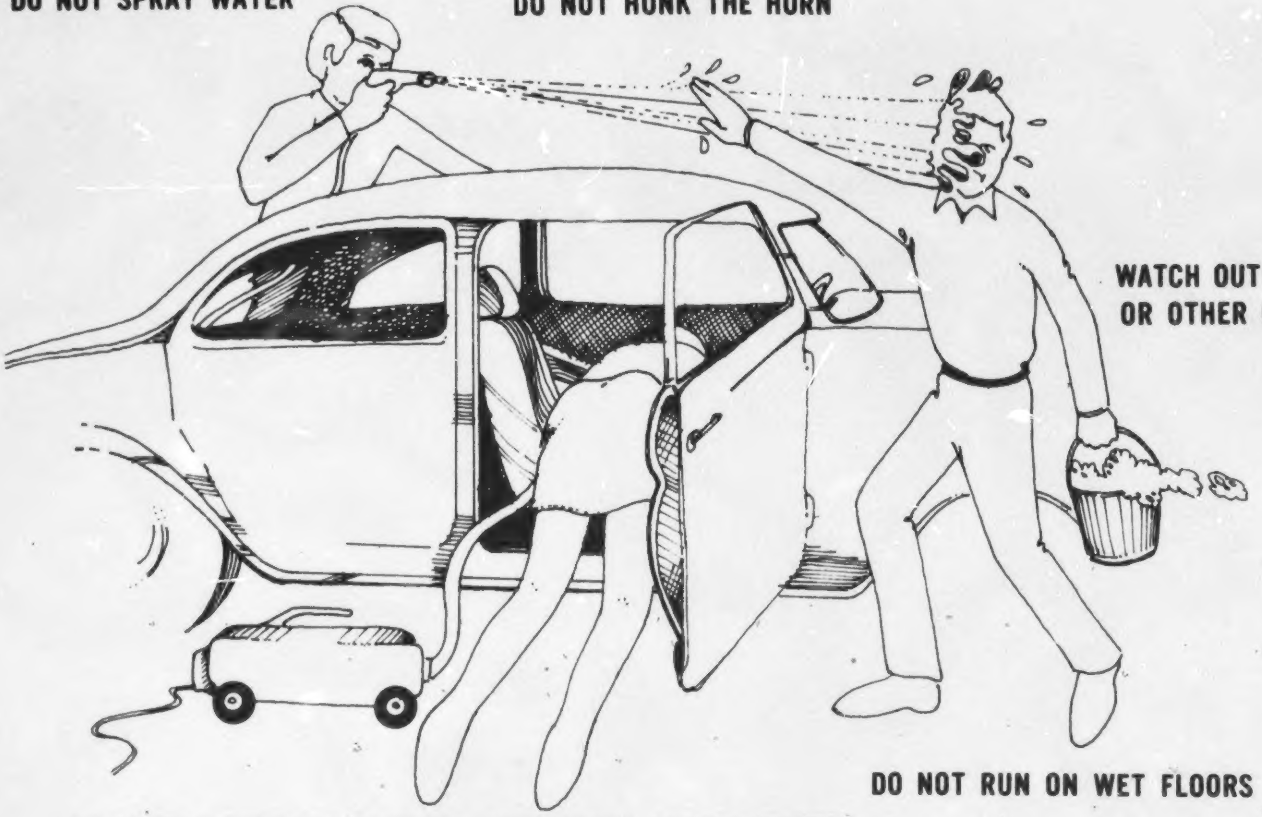


CLEANING PARTS



TM-1

CLEANING THE CAR



DO NOT SPRAY WATER

DO NOT HONK THE HORN

WATCH OUT FOR BUCKETS OR OTHER OBJECTS

DO NOT RUN ON WET FLOORS

BE CAREFUL USING ELECTRICAL APPLIANCES AROUND WATER

UNIT XIV

CLEANING THE CAR

JOB SHEET #1--CLEAN PARTS IN THE PARTS WASHER

I. Tools, equipment, and materials required

   A. Wire brush

   B. Scraper

   C. Parts washer

   D. Parts to be cleaned

II. Procedure

   (Note: Follow all safety rules.)

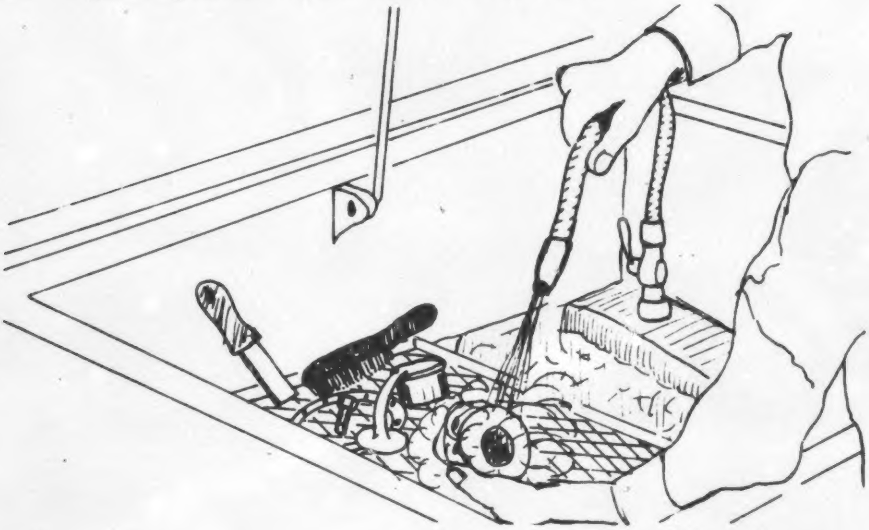
   A. Remove heavy grease and dirt deposits with scraper.

   B. Place parts in parts washer to soak.

   C. Turn on agitation cycle if the washer is equipped with one.

   D. Remove light grease and dirt deposits with a wire brush.

   E. Rinse parts with clean solvent.



F. Let parts drain.

G. Air dry parts.

H. Clean work area and turn in tools.

UNIT XIV

CLEANING THE CAR

JOB SHEET #2--WASH CAR EXTERIOR

I. Tools, equipment, and materials required

  A. Bucket of warm water

  B. Mild detergent

  C. Water hose

  D. Sponge or rag

  E. Chamois or terry towel

  F. Window cleaner

  G. Paper towels

II. Procedure

  (Note: Follow all safety rules.)

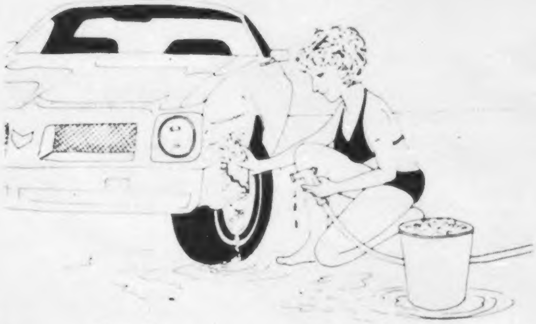
  A. Spray the car with the water hose until all surfaces are wet.

  B. Mix about one cup of detergent in the warm water.

  C. Apply the detergent solution to the car surface.

  D. Rub car finish as necessary to remove dirt or stains.

  E. Wash one panel or section at a time.



F. Rinse each panel washed before going to the next panel.

G. Continue this process until the exterior surface is clean.

H. Wash and rinse the wheels.

I. Rinse the chamois.

J. Wipe excess water from the car with the chamois.

(Note: Squeeze the water from the chamois when it becomes saturated.)

K. Clean the car windows with the cleaner and dry with paper towels.

L. Clean work area and turn in tools.

UNIT XIV

CLEANING THE CAR

JOB SHEET #3--WAX THE CAR SURFACE

I. Materials required

- A. Car wax
- B. Applicator cloth
- C. Polish cloth
- D. Chrome cleaner

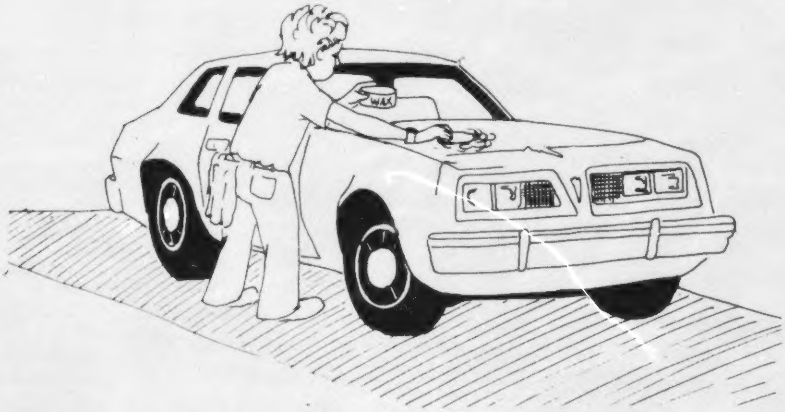
II. Procedure

(Note: Follow all safety rules.)

- A. Clean surfaces of car, if not already cleaned.
- B. Check to see if surface of car is cool.

  (Note: Do not wax in direct sunlight.)

- C. Apply wax to one panel at a time.



- D. Allow wax to dry.

  (Caution: If wax dries too long, it will be hard to remove.)

- E. Wipe dried wax off with a soft cloth.
- F. Continue this process until all panels have been

waxed.

G. Clean chrome on car with chrome cleaner.

(Note: If chrome cleaner is not available, wax the chrome surfaces.)

H. Clean work area and turn in tools.

UNIT XIV

CLEANING THE CAR

JOB SHEET #4--CLEAN AND VACUUM THE INTERIOR

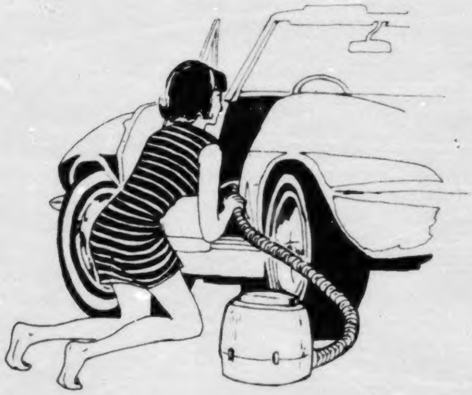
I. Tools and materials required

- A. Clean cloth or rag
- B. Whisk broom
- C. Upholstery cleaner
- D. Vacuum cleaner
- E. Spot remover

II. Procedure

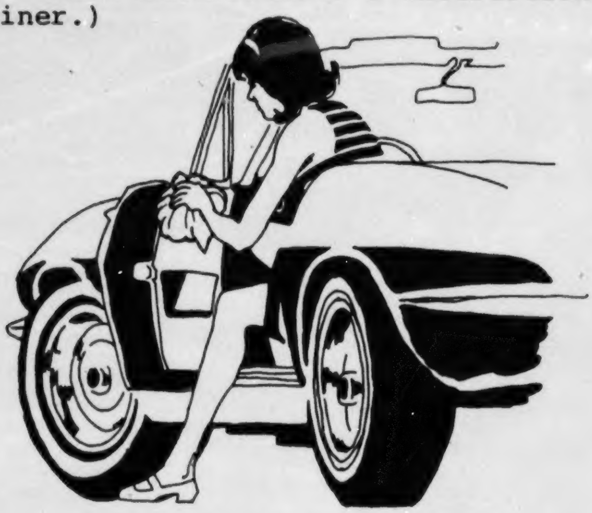
(Note: Follow all safety rules.)

- A. Dust the upholstery and carpet with the whisk broom to loosen any dirt or mud.
- B. Empty ash trays and litter bags.
- C. Vacuum seams and corners of upholstery.
- D. Vacuum all floor area.



E. Apply upholstery cleaner.

(Note: Read manufacturer's instructions on container.)



F. Apply spot remover on any area not cleaned with upholstery cleaner.

G. Empty vacuum cleaner bag.

H. Clean work area and turn in tools.

UNIT XIV

CLEANING THE CAR

UNIT TEST

1. Match the terms and definitions associated with cleaning the car.

_____a. A liquid used to dissolve or thin another material

_____b. A wide-bladed device used in removing grease and dirt deposits

_____c. A large vat filled with solvent and equipped with a soaking tray, a solvent agitator, and a filter for cleaning the solvent used in cleaning automotive parts

_____d. A thin leather skin used in removing water from windshields or from the car body's surfaces

_____e. A device supporting the lid of a parts washer that will allow the lid to shut automatically in case of fire

1. Chamois
2. Scraper
3. Solvent
4. Fusible link
5. Parts washer

2. Select the correct safety rules associated with cleaning the car by answering true or false to each of the following statements.

_____a. Gasoline can be used as a cleaning agent.

_____b. The work area should be well-ventilated.

_____c. Keep a fusible link on the parts washer.

_____d. Containers should be left open when not in use.

_____e. Solvent is not harmful to skin.

_____f. Read and follow all manufacturer's instructions on all containers.

_____g. Wear eye and face protection when using cleaners.

_____h. There is no special clothing for cleaning cars or their parts.

____i. Do not point air hoses or parts sprayers toward others.

____j. Never smoke around solvents or parts washers.

____k. Solvent vapors are not harmful when breathed.

____l. Always rinse parts thoroughly.

____m. The work area should be cleaned only if no one else is using it.

3. Identify the components of a parts washer from the list below.

Fusible link
Flush hose
Safety lid
Parts tray
Soaking vat
Brush

a.

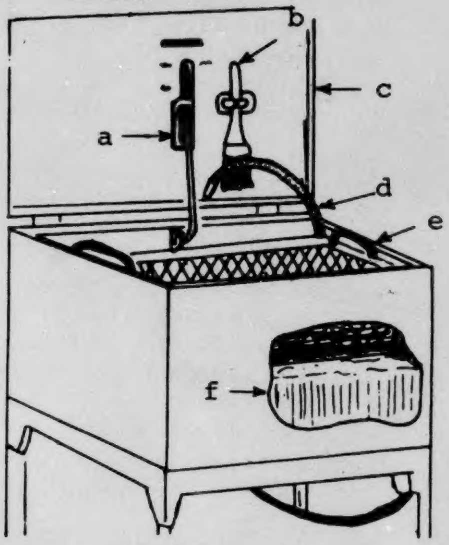
b.

c.

d.

e.

f.



4. Demonstrate the ability to:

   a. Clean parts in the parts washer.

   b. Wash car exterior.

   c. Wax the car surface.

   d. Clean and vacuum the interior.

(Note: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT XIV

CLEANING THE CAR

ANSWERS TO TEST

1. __3__ a.
   __2__ b.
   __5__ c.
   __1__ d.
   __4__ e.

2. a. False
   b. True
   c. True
   d. False
   e. False
   f. True
   g. True
   h. False
   i. True
   j. True
   k. False
   l. True
   m. False

3. a. Fusible link
   b. Brush
   c. Safety lid
   d. Flush hose
   e. Parts tray
   f. Soaking vat

4. Evaluated to the satisfaction of the instructor